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AUTHOR Berkemeier, Ginny Y. Hew
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ABSTRACT

Discusses multiple intelligence (a pluralized approach to understanding the intellect) teaching and learning of science at the higher education level, specifically within community colleges. The purpose of this study was four-fold. The first purpose was to investigate adult learning through Multiple Intelligence Theory (MI) at the community college level. The second purpose was to determine where there were any differences among students in their perceived MI with regard to age and gender. The third purpose was to investigate the relationship between perceived and tested MI strength with regard to science and non-science courses. Study participants were enrolled in science courses at Ozarks Technical Community College (OTC) (Missouri). The research methodology consisted of a combination of quantitative analysis, inventory and qualitative analysis and group interviews. Many positive outcomes were discovered in the study in areas such as the relationships between tested MI and perceived MI, student learning in science and non-science courses, and their relationships to age and gender. This study suggested the need for a variety of education and curriculum reform that should start with students' attitudes instead of classroom instruction or methods of teaching. Appended are the pilot study survey, research survey, pilot study data, and research survey key. (Contains 71 references.) (Author/RC)

EXPLORING MULTIPLE INTELLIGENCES THEORY AT A COMMUNITY

COLLEGE LEVEL

by

Ginny Y. Hew Berkemeier

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Ginny Y. Hew Berkemeier

has been approved

April 2002

APPROVED:

BRUCE FRANCIS, Ph.D., Faculty Mentor and Chair

PAM HANFELT, Ph.D., Committee Member

CAROLYN HOCH, Ph.D., RN, Committee Member

FRANK SHEPARD, Ph.D., Committee Member

LYNN MARTIN, Committee Member

ACCEPTED AND SIGNED:

BRUCE FRANCIS

Dean, School of Education

Abstract

The publication of "Frames of mind: The theory in practice", (Gardner, 1983) has been used by educators in a variety of ways to make teaching and learning more meaningful. However, little attention has been focused on the MI teaching and learning of science at the higher education level. Consequently, the purpose of this study was four fold. The first purpose was to investigate adult learning through Multiple Intelligence Theory (MI) at the community college level. The second purpose was to determine where there were any differences among students in their perceived MI with regard to age and gender. The third purpose was to investigate the relationship between perceived and tested MI strength with regard to science and non-science courses. The fourth purpose was to determine which MI teaching value relates best with science and non-science courses. Study participants were enrolled in science courses from a Midwestern community college, Ozarks Technical Community College (OTC). The research methodology of this research study consisted of a combination of quantitative analysis; using an inventory and qualitative analysis; through group interviews. Many positive outcomes resulted from the study in areas such as the relationships between tested MI and perceived MI, student learning in science and non-science courses, and their relationships to age and gender. This study suggested the need for a variety of education and curriculum reform that should start with students' attitudes instead of classroom instruction or methods of teaching.

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CHAPTER 1. INTRODUCTION TO THE STUDY

The history of intelligence has intrigued the human race since early ancient Greece. Early philosophers debated the nature and abilities of the human mind, which included who should be educated, and by what means. According to Gardner (1985) and Sternberg (1990), these questions will continue to be a topic of debate for centuries to come. Humans have long contemplated the quintessence of humanity and intelligence. The pursuit of knowledge and those abilities describing knowledge has been a subject of interest since Aristotle. Socrates, who stated the idea of "know thy self," hypothesized that individuals inherit different capabilities from birth while, Descartes, who postulated "I think, therefore I am," argued that the mind is the source of our knowledge (Gardner, Kornhaber, and Wake, 1996, p. 32-33). The great minds and philosophers of our time have pondered the question of mental importance for centuries.

One of the strongest advocates of learning using various intelligences is Howard Gardner (1985). Howard Gardner published, Frames of Mind: the Theory of Multiple Intelligences in 1983 and presented the first construct for multifaceted intelligence. Multiple intelligences theory (MI) is a pluralized approach to understanding the intellect. Gardner believes that MI offers everyone a justified and fair instrument so that all individuals can be successful. Gardner first intended MI for psychologists, but there was an overwhelming welcome and response from educators instead. According to Shearer (1996b, p.2), educators are no longer questioning, "How smart are you," but "How are you smart?"

Problem Statement

Since its inception, MI research has produced copious studies at the pre-collegiate level with an increasing body of literature indicating the impact of MI curriculum and its approach. There is very limited MI research peer reviewed and published beyond the secondary level. After searching the Internet, libraries, journal, and the UMI dissertation services, only 99 peer-reviewed studies (dissertation and thesis quality) were found from 1992-2001. 94 of the studies were conducted at the K-12 level while the other five studies were focused on post secondary. One of the post secondary research projects involved MI and remedial students, while the other four post-secondary projects involved the disciplines of computer science, art, and theater.

Consequently, the impact of MI on teens and adults is unexplored especially in the realm of MI and science education. The contention of this research study is to offer a viable framework for supporting the goals of science curricula as described by Hodson (1998, as stated below). Science educators would have the chance of breaking out of the traditional lecture and laboratory instruction and offer students a diverse style of learning, teaching and expanding their concepts of education. Notwithstanding, the opportunities of enhance self-directed learning and student reflection about their own learning, fostered by using more than the norm of logical-mathematical thinking.

Background of the Problem

The current conceptions of teaching and learning science curricula is to encompass a wide pool of students who have become scientifically literate through

integrated curriculum (Hodson, 1998). Hodson (1998) summarized his views of "critical scientific literacy" in three concepts:

1. Learning of science - where students learn to acquire and develop theoretical and conceptual knowledge of science through the understanding of the scientific method.
2. Learning about science- where students develop an understanding of the nature and methods of science, an appreciation of the history of science and its development and the awareness of the interactions of science, technology and society in our ecosystem.
3. Doing science – a definition, which, Hodson (1998, p.5) described as having students engaged in and developing critical thinking skills, inquiry and problem solving skills.

Council of First Ministers (1997) and Yagar (1993) believed that even though educators may emphasize these major concepts differently, these concepts represent the current conceptualization of the purpose of science education and learning. According to the Council of Ministers of Education (1997), scientific literacy is needed for science learning to transpire in a framework that allows development of adapted training to encourage innovative, original, and critical thinking skills with positive attitudes about science, and "a critical sense of wonder and curiosity about scientific technological endeavors" (p.5).

It is surprising that 18 years after the publication of Gardner's Frames of Mind, there is still a large population of data that remains untapped. One cannot begin to

imagine the possibilities of information and data that can be collected concerning MI and the adult population. There are several significant reasons why the student population at the community college level is important to the investigation of MI. First, there are approximately 48% of higher education students enrolled in community college systems, even though there is little published research with this population. Second, the enrollments of community colleges do not simply grow; in fact, they multiply. Third, community colleges are experiencing a tremendous growth by having open enrollment (Pascarella, & Terenzini, 1998). Fourth, in today's economy and employment market, there is a greater need for a college degree than ever (Deegan, Tillery, & associates, 1985).

Purpose of the Study

The purpose of this study was to investigate adult learning through MI at the community college level. With the growing emphasis on student motivation and student centered teaching, higher educational institutions must address a wide array of elements shown to influence student retention, motivation, learning, and completion of the program. The second purpose was to determine whether statistically significant differences existed among students in their identification of a particular dominant MI with regard to age, and gender. The third purpose was to look into the relationship of student perceived and tested MI strength with regard to science courses vs. non-science courses, and the overall grade in the respective courses. The fourth purpose was to determine which MI teaching value relates best with science and non-science courses.

Theoretical Basis for the Study

MI theory is a pluralized approach to understanding the intellect, which offers a viable framework for supporting the goals of educational curriculum such as those found in scientific literacy such as; the learning of science, the learning about science and the doing of science. If MI theory is reliable and infallible, educators from all fields (science and non-science) will be able to tap into their students multiple intelligences and to broaden their teaching repertoires by incorporating a variety of MI approaches into their pedagogy. In addition, students would be able to have more diversity in showing their interest, and knowledge, which enhances both student and teacher directed learning and teaching.

Gardner (1983) claimed that intelligence could not be characterized by a single, quantifiable test score and consists of numerous discrete abilities. Originally, Gardner (1983) came up with seven forms of intelligence but in 1995, Gardner added an eighth intelligence. Hence, the current types of intelligences authenticated by Gardner (1995) are – linguistic, logical mathematical, visual-spatial, bodily kinesthetic, musical, interpersonal, intrapersonal, and naturalist. Gardner (1983) believed that humans tend to use their intelligence in learning, decision-making, and ultimately choosing careers choices. MI theory varies from other educational reform efforts as Gardner, (1983) has yet to outline any principles for the implementation of MI in schools. Contrary to that, Gardner (1995) cautioned that:

MI theory is in no way an educational prescription...the theory does not incorporate a position on tracking, gifted education, interdisciplinary curriculum, the layout of the school day, the length of the school year, or many other "hot button educational issues. (p.206)

What is MI's appeal? One likely explanation is MI provides curricular support because the theory provides a mental model of intelligence. However, MI theory also offers educators the hope that all students are capable of learning. The philosophy of this research was to acknowledge that adult learners are highly capable and motivated with learning strengths and intelligences that are often underutilized by the methods used in studying, learning, and teaching practices of the student and the instructor.

Research Questions

The following are the research questions for this study:

1. What is the relationship between MI and course grades?
2. Are there significant differences when comparing student tested MI and criterions (dependent variable) such as age, gender, types of MI used in science and non-science courses?
3. What is the relationship between tested MI and the perceived MI?
4. Which MI value correlates best with science courses vs. non-science courses?

Hypotheses

Hypothesis 1. There is no significant difference between tested MI and course grades.

Hypothesis 2. There is no significant difference between tested MI and criterions such as age, gender, and types of MI used in science and non-science courses.

Hypothesis 3: There is no significant difference between tested and perceived MI.

Hypothesis 4: There is no significant difference perceived MI instructions in science and non-science courses.

Significance of the Study

Today's community colleges look for comprehensive treatment for its students. They expand their markets with courses and programs that were viewed as nontraditional in reference to clientele, location and delivery of instruction. Community colleges also differ in designating courses as credit versus non-credit. As discovered by Deegan, Tillery and associates (1985) study on community colleges, community colleges have identified their niche to the students. The variety of courses and small classrooms offered helps to maintain enrollments in economic recessions while allowing community colleges to continue to respond to community development (Deegan, Tillery, & associates, 1985).

This situation creates a unique opportunity and position for community colleges. Students previously unsuccessful or unprepared for a 4-year college are more successful after having achieved a learning of skill transition. A report by Janis Jones (1996) stated that community colleges use assessment instruments to determine initial placement in Mathematics and English courses. This allowed students to be more successful in courses that demand mathematic knowledge and language comprehension such as courses in pure science and social sciences. However, Patrice Jones (1998) found that in a national study of college transcripts (for both two- and four year colleges), 55 % of students who took no remedial courses eventually earned a degree while 47 % who took only one remedial course succeeded, and only 24 % of those who took three or more remedial courses

earned a degree. This correlated with Jones (1996), who reported that fewer than one out of six of California's students were successful after being placed in remedial classes.

With the growing concern of quality education and student retention, there is more emphasis placed upon motivation and instructional satisfaction from both instructor and student. In addition to this, administrators are looking into faculty teaching styles and student learning potential to impact retention, student achievement, and assessment. They hire instructors who are qualified in their area of emphasis. Many who were not trained in education pedagogy nor have any exposure to courses in teaching and instruction.

This study addresses a vital sector of today's education theory – MI theory and its relationship to student learning and potential achievement at the community college level. Ultimately, if it is determined that faculty teaching methods can improve student grades and retention, then possibly methods used in MI should be applied in all courses. This study may also be of interest to students, instructors, counselors, and administrators at community colleges who are concerned with success rates, improving retention, and improving curriculum standards. Indirectly, the results of this study may also influence the type of faculty professional development programs offered.

Nature of the Study

The research study is based upon a combination of quantitative and qualitative research. 152 students were surveyed for their view on MI. There were two groups of student volunteers involved; an experimental (n=83) and a control group (n=69). The quantitative research was based on an inventory, which calculated the participants tested

MI, investigated the participants perceived MI and the types of MI used in their science and non-science courses. The inventory was administered twice – pretest and posttest. Only the experimental group was exposed to a three-week intervention. The intervention consisted of groups of students (groups of 4) what worked on incorporating various types of MI in their science presentation. The qualitative research, a series of group interviews began after the posttest was administered for both control and experimental groups. Volunteer participants responded to ten standard questions, which are listed in the methods section of Chapter 3.

Assumptions and Limitations

Assumptions

The following assumptions would determine the successful analysis of this research:

1. Students are going to be truthful.
2. Students have the ability to perceive their MI strength and the type(s) of MI used in their courses.
3. Limitation of sample population.

Limitation of sample population

First, size and demographics of the study participants may create some limitations for the study. The sample population from this study simply generalizes to the student population of Ozarks Technical Community College (OTC) or community colleges with similar populations in the Midwest. Further generalization will require further studies.

Second, another limiting factor to the inventory relates to self-reporting. Surveys or questionnaires, and inventories do not represent complete objectivity. Isaacs and Michael's (1997; p. 137) listed four factors that may generate misleading information:

1. Surveys only tap respondents who are accessible and cooperative.
2. Respondents have to feel that their participation is a normal and natural process to avoid any form of slanted or bias answers.
3. The researcher has to be careful of arousing response sets.
4. Participants should be encouraged to not over rate or under rate their responses.

Procedure

The research study consisted of students enrolled in OTC for biology courses in the Fall 2001 semester. Volunteer student participants anonymously chose to participate in the research study. No rewards or inducements were granted. The participants were divided into two groups, the experimental group, which received an intervention, and the control group, which did not receive any intervention. The intervention consisted of three weeks of group assignments where students worked on presenting a unit in their science course on various science concepts. Through out the intervention sessions, in order to avoid biasness, the term or usage of multiple intelligences were never mentioned or discussed.

For the experimental group, the research process started with a pretest, a three-week intervention of group teaching, learning and studying methods, and a posttest. Contrary, the research process of control group consisted of the pretest, a waiting period

of three weeks (no intervention), and a posttest. Both the experimental and control groups were given the posttest in the fourth week.

Analysis of the Data

The tested and perceived MI of students was correlated to discover the extent to which they are related. Criteria (dependent variables) of age and gender were compared with tested and perceived MI strength, and science and non-science MI teaching in order to investigate their importance and how they relate to one another. In addition, the type of perceived MI used in the students current science and non-science courses were compared to search for the extent of their relationship. Furthermore, types of perceived MI used in these courses were compared against the student's tested MI. Lastly, the relationship between tested MI strength and the type of MI used in a course was also analyzed to look for significance in student success (i.e. grades such as A, B, C, or D).

Summary and Overview

Chapter I presents a description of the study and the focus of the dissertation topic. The theme of this study is to look into the MI strengths of community college students and their learning needs. The background of the problem, problem statement, purpose statement, and definitions of terms were included.

Chapter II provides a review of the literature describing the derivation, description, and educational implications of Howard Gardner's (1993a) MI theory.

Various types of MI instrumentation such as the instrumentation selected for this study were discussed, and described.

Chapter III addresses the methodology of the pilot and research study. This also included the type of student population studied and the instrumentation for the study.

Chapter IV presents the analysis from the pilot and research study.

Chapter V includes the summary of the pilot study and research, conclusions drawn from the research, recommendations, and implication for future research.

CHAPTER 2. REVIEW OF THE LITERATURE

Whether it is Plato's philosopher-king, the Hebrew prophet, the literate scribe in a medieval monastery, or the scientist in a laboratory, the individual capable of using his mental powers has been singled out. Socrates' "Know thyself," Aristotle's "all men by Nature desire to know," and Descartes "I think; therefore I am" provide epigraphs that frame an entire civilization. Even in that dark millennium that intervened between Classical times and the Renaissance, the ascendancy of intellectual factors was rarely challenged (Gardner, 1998).

Studies of educational beliefs and inquiry learning make up three decades of inquiry into the world of intelligence, which has prevailed for more than two millennia. The re-birth of ancient Greek ideas of the thought provoking mind-soul in the western world has redefined the term intelligence. The great fathers of philosophy – Homer (9th century B.C.), Plato (427-347B.C.) and Aristotle (384-322 B.C.) questioned the nature of the human mind and intelligence, which continues to intrigue the human race even to this day. Plato and Socrates constantly questioned how to test knowledge, what the criteria was for wisdom, and the social implications of innate distinctions among humans.

Early philosophers described intelligence as the ability to problem solve and learn through logic and geometry (Gardner, Kornhaber, & Wake, 1996). These particular attributes form a template for wisdom and human survival. Hence, the idea of educating others became the next step of passing on wisdom. Plato founded the Academy, and

Aristotle founded the Lyceum. These schools helped to teach subjects to learn and spread knowledge of contemporary curriculum such as science, mathematics, and literature.

In the history of science and research, the development of theory, and application of good scientific methodology are hand in glove, as each component is vital to the making of the other. The argument that is put forth in the field of intelligence and intelligence testing is of the interplay between theory and measurement, and how those ideas can diverge among researchers. This divergence is mirrored in the insistence of many people on the separation of quantitative and qualitative aspects of research and, many scientists have recognized their dependent roles in seeking to develop and understand both theory and phenomenon (Kuhn, 1977).

A Brief Summary of the Theoretical Foundations of the Intelligence Concept

The journey of the history of intelligence leads many researchers to infinite possibilities with each theory sounding increasingly probable. Early philosophers such as Homer, Plato, and Aristotle proposed the attributes of intelligence, which continues to challenge the scholars of today. These early philosophers described intelligence as the ability to learn, and to problem solve in specific areas such as logic, geometry and discourse (Gardner, et. al., 1996; Sternberg, 1990). Since then, the fundamental cornerstone of the Western philosophy of intelligence has been deeply rooted in the psyche of the people.

The modern concepts of intelligence emerged during the nineteenth century through the work of Sir Francis Galton (1822-1911). Galton's reparation toward the

involvement of heredity in intelligence was cited by the publication of Darwin's book, Origin of the Species (Clark, 1979; Davis & Rimm, 1989; Howley, Howley, & Pendarvis, 1986). Galton (1952) believed that the link between the physical and the mental included anthropomorphic, as well as psychophysical measures of sensory and fine motor performance as they were important criteria for intelligence and hereditary genius. While Galton was researching the intellectual differences and the relationship of physical characteristics, Alfred Binet explored the educational needs of France. In a 1883 article entitled "Le Raisonnement dans les Perceptions," (Reasoning in Perception), Binet realized that there were limitations to his theory but it would remain an influence on his thinking. This idea would resurface when Binet started developing the intelligence test. Binet would argue that "'intelligence' whatever else it was could never be isolated from the experiences, circumstances, and personal associations of the individual in question" (Fancher, 1985, p. 53).

A major step towards the development of psychometrics and its application in the field of intelligence evolved from the work of Binet and his colleague, Theodore Simon. Together, Binet and Simon developed a test for intelligence as a response to the French Education Department's need to be able to distinguish children who required special education attention from those who could benefit from normal classroom provision (Zusne, 1975).

Binet believed intelligence were multifaceted psychological faculties, tied together in reality and controlled by realistic judgment. Binet wrote

There is in intelligence, it seems to us, a fundamental agency the lack or alteration of which has the greatest importance for practical life; that is judgment, otherwise

known as good sense, practical sense, initiative, or the faculty of adapting oneself...Compared to judgment the rest of the psychology of the intellect seems of little importance. (quoted in Fancher, 1985, p. 74)

Even though Binet developed a scoring system, Binet maintained throughout his life that a single number should not be used to describe an individual's intelligence, as intelligence grows at different stages with age (Colangelo & Davis, 1991; Davis & Rimm, 1989). Binet always upheld the opinion that the test was intended only for healthy, motivated subjects who were from ordinary French culture (Fancher, 1985). Binet also believed that intelligence was not stationary. Intelligence was subjected to considerable change at different stages of one's life and the best method of accomplishing any intelligence testing is through case studies (Fancher, 1985). Binet wanted to help to improve education, not to label children as he became aware of the harm of his tests. Educators all over the world were misusing Binet's tests. Binet grew very concerned as teachers came to believe that they had un-teachable students. Binet noted that:

to admit implicitly that in a class where we find the best, we must also find the worst, and that this is a natural and inevitable phenomenon, which a teacher must not become preoccupied, and that it is like the existence of rich and poor in society. What a profound error. (1909/1973, pp.16-17)

Binet grieved on the various negative beliefs from the results of intelligence testing which caused an abdication of responsibility of educators to insure that all students had equal attention and equal quality instruction. It was William Stern in 1912 not Alfred Binet who developed the idea of the intelligence quotient (IQ) in 1912 while studying student scores on Binet's test. Stern noticed that the variations in mental age increase proportionally with the chronological age. Stern discovered that if the

chronological age were divided by the mental age and multiplying by 100, the ratio was constant (Carroll, 1982). Fancher (1985) explained that age implies more precision and carries a connotation of innate sequences more than Binet's term level.

Goddard opened the floodgates for the execution of intelligence tests for social uses and contributed in bringing the Binet-type test to the attention of the American public even though he has the dubious honor of probably being the first to be guilty of abusing intelligence testing (Fancher, 1985). Through Goddard's first testing in the United States and the overwhelming receptive audience in business, education and the military, everyone sought to measure individual differences through this inexpensive and relatively easy way of measurement. Stephen Gould (1981) pointed out that the implications of intelligence testing have had "momentous consequences in our century" (p.150). The psychometric movement started the demand for more constructive testing and better statistical analyses as well as scientific and social debate on the implications of intelligence and the testing for intelligence.

Unaware of the work of Binet and Simon, Terman began to develop an eight-part test consisting of creative and intervention imagination, logical processes, mathematical ability, language mastery, interpretation of fables, the game of chess, memory, and motor skill (Zusne, 1975). Terman upon discovering Binet's test was impressive primarily because it addressed some of the testing problems he had encountered with his theses (Fancher, 1985). Terman and his graduate student, Childs, noticed that scores on the Binet test were inflated for young American children, and deflated for older students. They set out to create a more accurate test for American students. This later became

know as the Stanford-Binet, which is the standard against all subsequent tests of intelligence measurement (Fancher, 1985).

Concepts of quantifiable, testable intelligence have permeated today's society. Casanova, Berliner, and Powell (1994) claimed that intelligence testing "have influenced educators' belief about what intelligence is, whether it is modifiable, genetic in origin differentially distributed across races and social classes and whether intelligence testing should be used or abandoned in schools" (p. 2). Many educators are confronted with whether their students' intelligence and ability to learn is modifiable through their teaching efforts or is it a lost cause since intelligence has been linked to the genetic code (Lemonick, 2000).

While Binet was developing his mental tests, Spearman's observations led him to hypothesize that all intellectual performances drew upon a unitary "general" intelligence or "g" (Spearman, 1927). The g factor is the highest-order common factor extracted in a hierarchical factor analysis from a battery of diverse statistical tests of various cognitive abilities. According to Stephen Ceci (1990), the majority of psychologists studying intelligence believe that the unitary mental energy underscores all cognitive abilities. However, contrary to the unitary view of intelligence, there are theorists who claim that the factor analytic research revealed a more complicated side of intelligence. It revealed a multi dimensional perspective of intelligence. Thurstone in 1938 suggested that intelligence consisted of multiple factors with which, Gardner (1983) based his groundbreaking theory of multiple intelligence.

Modern Conceptions of Intelligence

Gardner's MI concept is not new to the field of educational psychology. In fact, Truman Kelley published a book in 1928 entitled Crossroads in the Mind of Man; where he publicly criticized Spearman's model and set the stage for research into "various broad multiple factors central to intelligence" (Weiner & Stewart, 1984, p. 88). However, Gardner's MI concept is currently the most accepted and recognized by the field of educational psychology for its role in education in the 21st century.

Howard Gardner's theory of MI proposes that each individual possesses seven and as of 1995, eight, relatively autonomous intelligences. Gardner offered a definition for intelligence and a new approach to the theory of intelligence as he believed that "intelligence is the ability to solve problems, or to create products that are valued within one or more cultural settings – a definition that says nothing about either the sources of these abilities or the proper means of 'testing' them" (Gardner, 1985, p. x).

Gardner (1999a) deliberately used the word 'intelligence' due to its cachet. It is important to appreciate Gardner's view of intelligence as he believes that it is not though the idea of a unified force which accounts for an individual's abilities, but that intelligences must first be understood in the context of culture within which it occurs.

Gardner (1983) defined intelligence as

..a set of skills of problem-solving -- enabling the individual to resolve genuine problems or difficulties that he or she encounters and, when appropriate, to create an effective product -- and must also entail the potential for finding or creating problems thereby laying the groundwork for the acquisition of new knowledge (p.60)

Gardner (1993a) made it a point to differentiate between domains, fields, and intelligence. At the individual level, Gardner (1993a) felt that it is correct to indicate human intelligences as part of their birthright – intelligences that may be thought of in neurobiological terms. Humans are born into cultures that house a large number of domains – discipline and pursuits in which one has to become acculturated and assessed in terms of the level of competence. Within a society, interaction occurs primarily between the domains of the culture and the individual. Once a level of accepted competence is achieved, the field becomes very important because it renders judgment of the individuals' worth, quality of performance, and societal acceptance.

In Frames of Mind, Gardner (1985) proposed a novel psychological construct where intelligence is viewed in more ways than simply through the dry and statistical analytical lenses of (the widely accepted logical and linguistic) IQ-type formalized tests, or known as standardized testing used in most schooling systems today. Gardner questions the classical belief that humans can have only one 'mode of representation' about life. Instead, Gardner suggested that a more pluralistic viewpoint for measuring mental functioning ought to be addressed such as a variety of intelligent ways of thinking (1985). In other words, Gardner saw no reason to call logical thinking an "intelligence" and musical ability a "talent." Instead, Gardner (1985) believed these abilities to be equal.

Definition and Educational Implications of MI Theory

According to Gardner, the brain supports at least eight different abilities or intelligences. Each of these areas may develop relatively independently of one another. Individuals may have strengths and weaknesses and intelligences can be fashioned and combined in a multiplicity of adaptive ways, each being relatively independent of the others. The eight intelligences are linguistic, musical, logical-mathematical, spatial, bodily kinesthetic, interpersonal, intrapersonal (Gardner, 1995) and naturalistic (Checkley, 1987; Gardner, 1999a):

1. **Verbal-Linguistic Intelligence:** Individuals who are more able to utilize language as a means of expression, learning, and communication. Learns best by saying, hearing, and seeing words.
2. **Logical-Mathematical Intelligence:** Individuals who are more able to process logic, problems and equations. Learns best by categorizing, classifying, and working with abstract patterns/relationships.
3. **Visual-Spatial Intelligence:** Individuals who are able to spatially solve a puzzle, to comprehend shapes and images in three-dimensional sequences. Learns best by visualizing, dreaming, and working with colors or pictures.
4. **Musical Intelligence:** Individuals who are musically inclined. This includes individuals who use music to learn concepts and who are sensitive to rhythm. Learns best by rhythm, melody, and music.
5. **Bodily-Kinesthetic Intelligence:** Individuals who need hands on learning technique. This includes individuals who possess a certain control of their

movement, agility, and athletic ability based on a “natural sense” of how and what they are able to follow through and learn. Learns best by touching, moving, and processing knowledge thorough bodily sensations.

6. Interpersonal Intelligence: Individuals who are very sociable, need to interact, and interpret behaviors. Learns best by sharing, comparing, relating, cooperating, and interviewing.
7. Intrapersonal Intelligence: Individuals who need to have a sense of self, which leads to high self-esteem, strength of self-enhancement, and character. Learns best by working alone, self-paced instructions, and having personal space.
8. Naturalistic Intelligence: Individuals who are able to adapt to the environment (ex: have the ability to distinguish various species of flora and fauna). Learns best by hands on ability, categorizing things by common traits, and being outdoors.

Gardner (1993a) believed that some individuals develop certain intelligences more than others do, but every normal person should be able to develop each intelligence to some extent. MI theory supports the idea that intelligence can be taught and learned. This also suggests that mental performance can be improved at any age and at almost any ability level because “intelligence is a multi-dimensional phenomenon that occurs at multiple levels of our brain, mind, and body system. There are many ways by which we know, perceive, learn and process information” (Lazear, 1992; p8-9).

Educators embrace Gardner’s theory in part because it explains what educators have long experiences in their classrooms (Latham, 1997). MI is a way of thinking; it is an attitude about people, which allows for similarities and differences. It allows for

inclusion and enrichment, for self-esteem building and the development of respect for each individual and the first they bring to the classroom (Beckman, 1998, n.p.)

Even though Gardner and Hatch (1990) hoped that the stimulating nature of MI would encourage new thinking and support educational reform, Gardner has not come up with a survey for MI. In Gardner's (1999) *Frames of Mind Reframed: Multiple Intelligences for the 21st Century*, Gardner stated that:

"I once thought it possible to create a set of tests of each intelligence – an intelligence-fair version, to be sure – and then simply to determine the correlation between the scores on the several tests. I now believe that this could only be accomplished if someone developed several measures for each intelligence and then made sure that people are comfortable in dealing with the materials and methods used to measure each intelligence" (p.98).

Gardner (1999) explained that one reason for distancing himself from making quantitative measurements was to avoid "new forms of labeling and stigmatization" (p.98). Gardner stressed that MI should help individuals to learn important content and not be used as a way of categorization. Gardner (1999) topped off his view by stating "to use the language of one of my critics, I do not want to inspire the creation of a new set of "losers" " (p.98). Gardner (1999) also explained "... if such measurements of intelligences were developed, the findings would be of scientific interest – at least to me!" (p.98)

There are various questionnaires and "tests" that Gardner enthusiasts have created over the years but none as accepted by even Gardner himself as the Multiple Intelligence Developmental Assessment Scales (MIDAS) created by Branton Shearer of Kent State University in 1987. In 1996a, Shearer revised his assessment to include the eighth intelligence in the MIDAS assessment. According to Shearer (1996b), the MIDAS

instrument generates "information regarding intellectual development, activities and propensities not generally available from standard intelligence and most aptitude tests" (p1). Shearer's assessment methods provide data on a broader spectrum of dimensions for informed choices. These methods are based upon the idea of personalized education. Recently, according to Shearer (2002, n.p.), Howard Gardner congratulated Shearer for his efforts to:

... measure the multiple intelligences, which have been developed according to the standard psychometric procedures. Branton Shearer is to be congratulated for the careful and cautious way in which he has created his instrument and offered guidance for its use and interpretation.

Applying MI in Higher Education Institutions

"Most scholars...are now convinced that enthusiasm over intelligence tests has been excessive and that there are numerous limitations in the instruments themselves and in that uses to which they can (and should) be put" (Gardner, 1993a, p.16). Gardner (1991) believed that despite exposure to theoretical knowledge, college students often revert to the uninformed opinion of the unschooled mind of a five-year old. Gardner (1991) also stated the necessity to identify early representations, to confront these assumptions repeatedly, and directly in order to educate for genuine understanding. Gardner's (1991) confidence in his MI theory derives from cognitive research evidence where many of the early cognitive representation theories are powerful, and difficult to change. Consequently, once a student learns a new idea for the very first time, it is difficult to change that perception or knowledge if the information learned was incorrect (Gardner, 1991).

The MI approach would design curriculum and instruction around the students' needs while offering a variety of methods of "learning and understanding" (Hoerr, 1996, p. 18-19). Gardner (1997b) advocated that MI is a powerful tool for teaching and preparing students beyond school. Gardner (1997b) asserted that MI approach develops a student's full potential for mastering core information. Jordan (1996) supported Gardner's enthusiasm on the power of MI as a teaching tool because "by emphasizing students' abilities rather than disabilities, Gardner validated such accomplishments as significant products of right brain function, which are seldom evaluated in standardized tests" (p.30).

Bolanos (1996) believed that any potential wind of change in teaching methodology at higher institutions required modification of traditional mental models of intelligence and teaching – something with which higher education instructors are not comfortable. With the demand for student retention, and supplementary experimentation with enhancement courses through the Internet, and experimentation with nontraditional methodologies like distance learning, there is an emergence for reaching students from all aspects of learning (Bolanos, 1996; Smagorinsky, 1996). Today's' education system is confronted with a more diverse set of learners who possess a broad spectrum of interests and abilities. MI has been able to fill that niche by providing critical insight to improving assessment and instructional methodology (Lantham, 1997; Visser, 1996).

Science Education and Literacy Reform

Educators need to be aware of "the status and nature of scientific knowledge; how it is created and how dependable it is" (Harlen, 1992, p.2). The traditional method of viewing science has been simply a collection of theories, facts and hierarchical classification of organisms, which is mastered by students who develop a narrow perspective of what science is (Wasserman & Ivany, 1996). Wasserman and Ivany (1996) believed that science should involve learners in learning about and learning to do science in a context that fosters critical thinking, enjoyment, and understanding of science, technology and society (STS).

Many curriculum reform initiatives were initiated by reactions to perceived deficiencies in existing curricula (Hodson & Reid, 1988). The National Science Teachers Association began a reform initiative in the 1960s that aimed for scientific knowledge and scientific methods where "the conceptual schemes of science" and "the process of science" are vital to the impact of content and structure of science curriculum (Bybee, 1993, p.12). Thirty years later, DeBoer (1991) and Aikenhead (1994) responded to the new vision of "science literacy" as a need to develop curricula that would prepare students to be citizens who understand science as an activity with personal relevance to political, social, and economic implications to society. Fensham (1987, p.22) poured the foundation stating that new science programs need more than inductions to science but an increased involvement of "more learning about and from science". Aikenhead (1994, p.49) summarized it best when he stated "science content is integrated with

students' everyday worlds, and in a manner that mirrors students' natural efforts at making sense out of those worlds".

Matthews (1994) stated that "there is no one correct definition of science literacy; it is a matter of different conceptions proving their worth for the promotion of particular ends" (p.31). Matthews (1994) explained that the conceptions of science literacy may be general or specific but a liberal conception may be a more appropriate approach.

Matthews (1994) cited that understanding fundamental concepts and laws, an appreciation of scientific method, connecting science to everyday life, recognizing science with related technology, and understanding how the history of science have shaped culture, history and moral forces are important (p. 32-33). Wassermann and Ivany (1996) asserted that it is unfortunate that the particular conception of scientific literacy held by most science educators have been in all likelihood, determined by what is taught in science lessons, and how it will be taught. Therefore, one of the most prevalent themes in recent conceptions of science literacy is STS. STS, means different things to different people but is generally accepted as understanding science embedded in a social context in one coherent curriculum.

MI teaching and learning if adopted as a framework could provide a cascade of events that hope to promote active, student centered learning (Adams & Hamm, 1998). Adams and Hamm (1998) recommended a combination of student centered learning and MI theory where the objectives of learning is pluralized. Adams and Hamm (1998) believed that MI provided a framework to foster teacher reflection. The framework would allow educators to broaden their approach to teaching and assessment, and to personalize

learning for their students. Furthermore, Adams and Hamm (1998) believed that focusing on students MI strength would open the door for conceptual change in the learning of science. The researchers believed that students needed time for reflection, to share ideas, to give and received feedback and to improve their communication skills (Adams & Hamm, 1998).

MI theory has been suggested by several researchers to play a significant role in supporting the goals of scientific literacy by fostering a learner-centered approach to education (Adams & Hamm, 1998; Aikenhead, 1994). The focus on internal intelligences in science classes from a learner-centered approach can be a gateway to a collaboration of conceptual understanding, sharing of ideas and feedback. Such interactions necessitate the use of critical and higher order thinking, communication skills, and meta-cognitive skills, which embraces MI theory. This section approached differing conceptions of science education and literary have been presented, although the literature rallies around the three components of science: learning science, learning about science and doing science (Hodson, 1998). There seems to be many researchers who are interested in using various teaching and learning theories to achieve Hodson's (1998) components of science but there is not enough research on MI in integrated science at all levels of education. It is disappointing to report that there seems to be little education research specifically in science at the community college level.

MI Assessment Instruments

Research on various types of MI assessment has uncovered various types of instrumentation – mainly for primary and middle school students. The following are MI instruments that have been used in some capacity to test older students (secondary to adults), which have been considered as an assessment instrument for this research study:

1. MI inventory for adults by Thomas Armstrong (1994; 2000)
2. Multiple Intelligence Teaching Approach (MITA) for adults by Ellen Weber (2000).
3. Multiple Intelligence Development Assessment Scales (MIDAS) by Branton Shearer (1996a, 2002).

MI inventory by Thomas Armstrong (1994; 2000) included ten statements for each intelligence category. Armstrong (1994) believed that his survey was not a test but a quantitative measurement of information. Armstrong's' (1994) inventory consists of a total number of checks for each intelligence and he felt that the "quantitative information had no bearing on determining one's intelligence or lack of intelligence" (p.17). His purpose for the survey was to appraise individual performance and to find a link from one's life style and experiences with MI theory. The absence of quantifiable data was not a meaningful choice to use this instrument.

Multiple Intelligence Teaching Approach (MITA) by Ellen Weber (2000) includes 40 questions, which were randomly assigned. Weber (2000) believes that adults are able find their MI "gift" by checking off 15 out of the 40 questions in the MITA survey. An answer key is prearranged to assess which questions relate to which

intelligence. Weber has not worked on any reliability tests with the MITA surveys (personal communication, April 2001).

Multiple Intelligence Developmental Assessment Scales (MIDAS) by Branton Shearer (2002) is one of the few comprehensive attempts to measure MI. Gardner also helped to serve as a resource expert in Shearer's (2002) MIDAS instrument. The MIDAS questionnaire is a 119-item self-report that describes a person's intellectual disposition using all eight intelligences. Each item uses a five point Likert scale with a range of responses for each question. In order to find the most suitable instrument in this study, a hybrid of Armstrong (2000), Weber (2000) and Shearer's (2002) approach to questioning were used as the template for the pilot survey. The survey also considers the reading and comprehension level of the average community college student with the advisement and critique of a panel of volunteer students and instructors of the research site at OTC.

Summary

This chapter reviewed the historical and modern literature concerning intelligence and Howard Gardner's MI theory. This chapter also suggested how educators should examine their assessment of student learning and the inclusion of MI learning. At the community college level, there should be standards that all educators should uphold. Evelyn (1999) found a surge of dissatisfaction with developmental education that is spreading across the country. According to Evelyn (1999), all community colleges and 63% of four-year colleges now offer remedial courses. The primary role of a community college is to help students to prepare themselves for a four-year degree. With an open

enrollment policy, and rising number of incoming students who do not have the appropriate learning skills, some community colleges are doing a disservice by allowing these students to complete their course work because of the two-year commitment. Community colleges also help to intensify remedial education, and to help students in completing a two-year associates degree if they do not have the necessary reading comprehension, mathematics, and critical thinking skills that a college level curriculum demands (Evelyn, 1999).

Educators should not be held accountable if the students are not willing to open their books and study. Both student and teacher should try to come to some agreement of assessment and accountability and the MI approach opens many possibilities for:

“...paradigm shift because it changes the way we look at students and their potentials...each school’s implementation of MI will be culture-specific, context-specific, and school-specific...something that is best done by faculty members working together as colleagues creating strategies for their unique teaching situation” (Hoerr, 1996, p.9-10).

CHAPTER 3. METHODOLOGY

Research Approach

Student motivation, self-perception and knowing how to use one's MI strength are fundamental skills to a student's success in higher education. To analyze whether students are able to correctly perceive their MI strength versus their tested MI, students from OTC were given an inventory that would help determine tested MI strength. This research sought to determine whether MI strength of an individual and the types of MI strength used in a particular course is indicative of a student's potential success. Such an analysis would help educators evaluate the value of MI at the higher education level and how to help students to be successful.

Research Design

The inventory consisted of questions that enabled the researcher to determine the tested MI strength of the students and compare the results with the student's perception of their MI strength. A pilot study was conducted (pre-and post-test with an intervention of 2 weeks and a 30 minute class discussion on MI) for the purposes of testing the reliability of the instrument and developing the procedures for the research study.

Target Sample Population and Sampling Procedure

The research study focused on students enrolled in non-majors biology courses at OTC in fall 2001. The researcher approached the students for their volunteer participation. All surveys were administered at the same time to ensure that the survey

was administered and returned in a timely fashion. Factors such as gender and age of the sample student population were also analyzed.

Instrumentation

Data was gathered using the following measures. To gauge student tested MI, a combination of questions from Dr. Ellen Weber's MITA (2000; See Appendix B) and Dr. Thomas Armstrong's MI survey (2000; See Appendix C) was used to build the tested MI questions (Questions 1-40). The researcher combined Weber's (2000) and Armstrong's (2000) survey ideas to meet the needs of the study. The tested MI questions were rewritten (i.e. change the wording and style of questioning) to complement the reading level of the average student population at OTC. Approval from the humans participation committee at OTC and Capella University was obtained before researches on human participants were carried out. The researcher had volunteer students in her fall 2000 biology for non-majors course and various faculty members in the science department at OTC to "proof" read for clarity, refine wording, improve readability, comprehension of the questions, and average time it takes to read the questions. Unfortunately, neither surveys by Weber (2000), and Armstrong (2000) have been tested for reliability and validity. Therefore, the purpose of the pilot study was to test the reliability of the inventory.

The self-reporting inventory consisted of short descriptive phrases of individual characteristics, definitions of the different types of intelligences, and type(s) of MI used in science courses vs. non-science courses. The final product from the combination of

Weber's (2000) and Armstrong's (2000) survey ideas met the needs of this research inventory. A 69-item instrument was drawn from descriptive characteristics of MI theory and identifiable incidents or behaviors to ascertain specific skills. Each item used a five point Likert scale with a range of responses for each question.

The first 50 questions were tested MI questions composed of frequency or duration of a particular activity, evaluation of performance as recognized by others, and enthusiasm for a particular activity (see Appendix A). The second set of questions, (questions 41-48) were for self perceived MI where the participant would choose which MI strength best described their characteristic. The third set of questions, (questions 49-65) related to MI used in their science and non-science courses. The fourth set of questions, (Questions 66-69) were demographic questions about the participants' age and gender. Participants rated how each statement describe their personality (tested MI and perceived MI), and the type(s) of which MI statement best described their science and non-science courses. The pilot study results can be found in Appendix F.

Research Study

Sample Population

Several wordings and headings were altered from the pilot survey to avoid any language biases (see Appendix D). The research population consisted of students who were enrolled in non-majors science courses in the fall 2001 semester at OTC. These participants were recruited from biology courses such as General Biology (BIO 100) and Anatomy and Physiology (BIO 120). No rewards or inducements were given. Responses

in this study were based on voluntary participation. The research study sample consisted of 152 participants who volunteered their participation with the assurance that their responses would be anonymous.

Procedure

The researcher first approached the instructors of BIO 100 and 120 for their participation in the inventory. The participating instructors announced to their classes about conducting an inventory on student learning which consisted of two parts – a pretest and a posttest. Students were aware that their participation was voluntary, and no rewards or inducements were granted. Students who were not interested in volunteering were excused from the inventory. In addition to the quantitative inventory analysis, the researcher also included a qualitative component to the research. The qualitative study consisted of group interviews of volunteer student participants (four participants per group) from both control and experimental groups. The style of the interview process was rather open ended with the exception of ten predetermined questions on student learning and perception of learning strength in relation to MI. All responses were anonymous. The researcher used recordings (when permitted) and hand written notes during the interviews.

Pretest

The researcher asked for a student volunteer from the participating students. The student volunteer was instructed on how to administer the inventory. The researcher

would leave the room before the inventories were handed out. Once the participants completed their responses, both the inventory and the scantron answer sheet were returned to the student volunteer. The student volunteer sealed the inventory and scantron responses in an unmarked envelope, and returned the sealed unmarked envelope to the researcher's mailbox.

Intervention

There was a three-week intervention between the pretest and posttest. The intervention consisted of group activity and presentations using themes connected to MI. Students were exposed to MI teaching and learning techniques throughout the three week period.

Posttest

Three weeks after the pretest, the researcher requested student voluntary participation to ensure that all students who participated in the pretest were given the choice to further their participation in the posttest. A student volunteer was requested to re-administer the survey to the voluntary participants. After the inventories were completed, the same protocol for handing in the survey and scantron as the pretest was repeated.

Data Collection

Scantron from the pretest and posttest were matched for the random identification codes that students received. The researcher hand scored both pretest and posttest scantron. The data collected were recorded onto a spreadsheet. The researcher recounted and reread the scantron (five times not including initial count) to check for accuracy of data entry. The researcher would crosscheck and confirm all recording by going through the scantron randomly, and cross check with the data entered in the spreadsheet program at the end of each session. The data were then analyzed to answer the research questions.

Research Questions

1. Are there significant changes in student learning behavior once exposed to multiple intelligence curriculum?
2. Are there significant differences when comparing student tested MI and criterions (dependent variable) such as age, gender, types of MI used in science and non-science courses?
3. What is the relationship between tested MI and perceived MI?
4. Which teaching MI value correlates best with science courses vs. non-science courses?

Data Analysis

Data analysis combined both quantitative and qualitative methods. The predominant statistical analysis consisted of examining the relationships among variables

and the frequency of responses from categories such as gender, age, and science vs. non-science courses. In addition, an analysis of levels of tested MI strength and perceived MI strength and comparing the results by age, gender and type of course (science vs. non-science) was conducted.

CHAPTER 4. DATA COLLECTION AND ANALYSIS

The purpose of chapter IV is to describe and present the data and the relationship of the study within the framework of the research questions. Chapter IV is divided into quantitative and qualitative results, and both having the following subdivisions:

1. Data description
2. Analysis of the relationship
3. Exploration of the results

Quantitative Analysis

Data Description

In Chapter I, it was established that the sample population from this study simply generalizes to the student population of OTC or community colleges with similar populations in the Midwest. After administering the survey, the study population was compared to the national population in order to determine differences. Table 1 shows the comparison of experimental and control student population by age and gender at OTC and the national average reported by Phillippe (1997).

The first demographic considered was age. The variations were apparent when compared to the national community college average. The National Center for Educational Statistics (NCES) study reported that the average national community college student's average age is 29 years (Phillippe, 1997). In this study, the average age of the student population at OTC is between 18-20 years of age. Thus, the average age of

the student population in this study is younger (average of nine years difference) than the national community college average (Table 1).

Table 1. Comparison of experimental and control student population by age and gender.

AGE	EXPERIMENTAL		CONTROL		STUDY %	U.S.%
	MALE	FEMALE	MALE	FEMALE		
18-20 years	26	28	1	24	54.79	20.0
21-23 years	4	8	0	10	15.06	25.1
24-26 years	3	3	0	8	9.58	6.85
27-29 years	1	3	0	3	4.79	6.85
Above 30 years	2	5	4	19	20.54	41.2

The second demographic considered was gender distributions. There are more females (76.02%) than males (23.98%) enrolled in OTC. The female population at OTC is higher (19.02%) than the average female population found nationally while the average male population is lower than the average male population (-22.98%) (Phillippe, 1997). The national average for gender reported by Phillippe (1997) was female population of 57% and male population of 42%. Thus, the student gender population in this study does not approximate to the national population statistics.

The third demographic considered was ethnicity. The control and experimental student ethnicity populations were compared to the National Population Projections (Day, 1999). The average OTC Caucasian student population was 13.7% higher than the national population projection average while the collective minority representation at OTC was lower than the national population projection average of 13.7% (Day, 1999).

There was not enough variance to account for variability due to the lack of representation in each ethnic category presented in this study (Tables 2 and 3).

Table 2. Comparison of ethnicity and age of experimental group and National Projections Populations (U.S. % from Day, 1999).

ETHNICITY	AGE					Research Study %	U.S %
	18-20	21-23	24-26	27-29	above 30		
African American	3	0	0	0	0	3.7	12.3
Caucasian	46	12	6	4	7	90.3	75.7
Hispanic	2	0	0	0	0	2.4	9.0
Asian	0	0	0	0	0	0	3.0
Native American	0	0	0	0	0	0	0.8
Other	3	0	0	0	0	3.6	---

Table 3. Comparison of ethnicity and age of control group and National Population Projections (U.S.% from Day, 1999).

ETHNICITY	AGE					Research Study %	U.S %
	18-20	21-23	24-26	27-29	above 30		
African American	2	0	0	0	0	2.9	12.3
Caucasian	21	9	8	3	20	88.5	75.7
Hispanic	0	0	0	0	0	0	9.0
Asian	0	0	0	0	0	0	3.0
Native American	0	0	0	0	3	4.3	0.8
Other	2	1	0	0	0	4.3	---

Analysis of Relationship

There were four research questions to address in this study. The first research question: Are there significant changes in student learning behavior once exposed to multiple intelligence curriculum? Four analysis using paired samples T-test of pretest and

posttest of tested MI, perceived MI, science MI (bio MI) and non-science (non-bio MI) were investigated.

The first analysis consisted of paired samples T-test of the gain scores on the pretest and posttest for tested MI for the experimental and control group (see Table 4).

Table 4. Paired samples t-test for tested MI of experimental and control groups.

Experimental	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.00	.289	.00	-.608	.545
Logical	.00	.929	.10	.591	.556
Visual	-.12	.787	.00	-.1.39	.167
Musical	-.10	.841	.00	-1.17	.244
Bodily	-.23	1.040	.11	-2.00	.048*
Inter	.00	.781	.00	.00	1.00
Intra	-.16	1.042	.11	-1.37	.174
Natural	.53	.958	.10	5.20	.000*
Control	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.00	.658	.00	1.09	.276
Logical	.166	.582	.00	1.65	.103
Visual	.00	.577	.00	1.04	.301
Musical	.00	.612	.00	1.18	.242
Bodily	.145	.692	.00	1.74	.086
Inter	.00	.588	.00	-1.23	.223
Intra	.101	.860	.10	.98	.331
Natural	-.145	.648	.00	-1.85	.068

* $p < 0.05$ level

There was a significant difference for tested MI in the experimental group for bodily kinesthetic intelligence ($p = 0.048$) and naturalistic intelligence ($p = 0.000$). Participants in the experimental group showed an increase in kinesthetic and naturalistic intelligence strength after the intervention. Contrary, there were no significance differences in the control group.

The second analysis consisted of paired samples T-test of the gain scores on the pretest and posttest for perceived MI for the experimental and control group (see Table 5).

Table 5. Paired samples t-test for perceived MI of experimental and control groups.

Experimental	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	-.52	1.22	.13	-3.858	.000*
Logical	.00	1.19	.13	.185	.854
Visual	.22	1.16	.13	1.705	.092
Musical	.23	1.32	.14	1.581	.118
Bodily	-.11	1.16	.13	-.853	.396
Inter	.17	1.17	.13	1.317	.192
Intra	.17	1.22	.13	1.262	.211
Natural	.00	1.3	.14	.422	.674

Control	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.00	1.17	.14	.410	.683
Logical	.29	1.24	.15	1.945	0.56
Visual	.00	1.21	.15	-.597	.552
Musical	.33	1.39	.17	1.992	.050*
Bodily	.14	1.09	.13	1.106	.273
Inter	.00	1.26	.15	.191	.849
Intra	.29	1.32	.16	1.826	0.072
Natural	.26	1.08	.13	2.007	.049*

* $p < 0.05$ level

There was a significant difference for perceived MI in the experimental group for verbal linguistic intelligence ($p = 0.000$). Meanwhile, the control group showed significant difference for musical intelligence ($p = 0.050$) and naturalistic intelligence ($p = 0.049$). It is important to recognize that the noteworthy perceived MI was contradictory for the experimental and control groups. In addition, the noteworthy results from the overall student perception of their MI strength in both control and experimental groups differ from overall tested MI strength significance.

The third analysis consisted of paired samples t-test of the gain scores on the pretest and posttest for science MI for the experimental and control group (see Table 6).

Table 6. Paired samples t-test for science MI of experimental and control groups.

Experimental	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.11	1.02	.11	.964	.338
Logical	.00	1.22	.13	.269	.789
Visual	.27	1.13	.12	2.143	.035*
Musical	.00	1.20	.13	-.639	.524
Bodily	.00	1.09	.12	.303	.763
Inter	.24	1.12	.12	1.957	.054
Intra	.33	1.16	.13	2.556	.012*
Natural	.00	1.00	.11	.220	.827
Control	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.32	.99	.12	2.668	.010*
Logical	.32	1.19	.14	2.218	.030*
Visual	.30	1.30	.16	1.947	.056
Musical	.00	1.33	.16	-.271	.787
Bodily	.00	1.17	.14	-.410	.683
Inter	.16	1.18	.14	1.119	.267
Intra	.32	1.24	.15	2.132	.037*
Natural	.28	1.07	.13	2.139	.036*

* $p < 0.05$ level

There was a significant difference for science MI in the experimental group for visual intelligence ($p = 0.035$) and intrapersonal intelligence ($p = 0.012$). The control group showed significant differences for verbal intelligence ($p = 0.010$), logical intelligence ($p = 0.030$), intrapersonal ($p = 0.037$), and naturalistic intelligence ($p = 0.036$). In both groups, participants on the average ranked themselves higher (somewhat like me) in the pre-test.

The fourth analysis consisted of paired samples t-test of the gain scores on the pretest and posttest for non-science MI for the experimental and control group (see Table 7).

Table 7. Paired samples t-test for non-science MI of experimental and control groups.

Experimental	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.17	1.34	.15	1.145	.255
Logical	.23	1.41	.15	1.481	.142
Visual	.00	1.28	.14	.428	.670
Musical	.00	1.38	.15	.00	1.00
Bodily	.00	1.24	.14	.265	.792
Inter	.00	1.30	.14	.508	.612
Intra	.13	1.30	.14	.932	.354
Natural	.00	1.39	.15	.079	.937

Control	Mean	Std. Deviation	Std. Error	t	Significance
Verbal	.17	1.26	.15	1.147	.255
Logical	.41	1.29	.15	2.619	.011*
Visual	.00	1.34	.16	-.269	.789
Musical	-.16	1.20	.14	-1.107	.272
Bodily	.14	1.60	.19	.751	.455
Inter	.38	1.23	.15	2.553	.013*
Intra	.49	1.15	.14	3.573	.001*
Natural	.00	1.37	.16	.528	.600

* $p < 0.05$ level

There was a no significant difference for non-science MI in the experimental group.

However, the control group showed significant difference for logical intelligence ($p = 0.011$), interpersonal intelligence ($p = 0.013$), and intrapersonal intelligence ($p = 0.001$).

Control participants on the average ranked themselves higher (somewhat like me) in the pre-test while the experimental participants on the average, did not change their perception of MI used in their science courses.

The second research question: Are there significant differences when comparing student tested MI and criterions (dependent variable) such as age, gender, types of MI used in science and non-science courses? The analysis consisted of paired sample t-test of the gain scores tested MI gain scores (gain score = posttest MI – pretest MI) were compared to criterions of age, gender, science and non-science courses.

The first analysis consisted of comparisons of tested MI gain scores, gender, and age of the experimental and control group (see Table 8). There was a significant difference in interpersonal MI between males and females of the experimental group. ($p = 0.02$). Females rated interpersonal MI higher (more like themselves) than males in the experimental group. In the control group, there were significant differences between visual intelligence and gender ($p = 0.03$). In the experimental group, only bodily intelligence and age was significant ($p = 0.02$) while the control group did not show any significance for age and tested MI.

The second analysis consisted of comparisons of tested MI gain scores and science (bio) MI using Pearson's correlation analysis to look for relationships for experimental and control groups (see Table 9). Eight significant differences were found in the experimental group when correlating tested MI and bio MI. The noteworthy differences were, i) tested verbal and bio verbal ($p = 0.00$), ii) tested visual and bio logical ($p = 0.05$), iii) tested visual and bio visual ($p = 0.041$), iv) tested logical and bio musical ($p = 0.041$), v) tested visual and bio bodily ($p = 0.043$), vi) tested intrapersonal and bio intrapersonal ($p = 0.00$), vii) tested naturalistic and bio naturalistic ($p = 0.00$), and viii) tested verbal and bio grade ($p = 0.024$, see Table 9). It is interesting to note that only

Table 8. Tested MI gain score using Pearson's correlation analysis to look for relationships in age and gender for experimental and control groups.

Experimental	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural	Gender	Age
Gender	0.00	-0.08	0.10	0.08	-0.14	0.25	0.08	0.21	1.00	0.13
	0.98	0.45	0.35	0.45	0.22	0.02*	0.48	0.06		0.25
Age	-0.01	-0.05	-0.09	-0.11	0.25	-0.06	-0.06	0.04	0.13	1.00
	0.93	0.64	0.40	0.31	0.02*	0.58	0.61	0.72	0.25	
Control	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural	Gender	Age
Gender	-0.04	0.04	0.26	-0.04	-0.06	-0.15	-0.16	-0.11	1.00	-0.22
	0.76	0.74	0.03*	0.74	0.63	0.22	0.18	0.36		0.07
Age	-0.09	-0.09	0.02	-0.10	-0.07	0.16	-0.16	0.14	-0.22	1.00
	0.46	0.45	0.89	0.43	0.57	0.19	0.19	0.25	0.07	

* $p < 0.05$ level

First row = Pearson Correlation

Second row = p-value

in the experimental group, tested verbal intelligence increased students science (biology) grade.

Contrary, the control group had five noteworthy relationships between tested MI and bio MI, which were independent from the findings in the experimental group (see Table 9). Noteworthy relationships were found between: i) tested logical and bio-verbal ($p = 0.047$), ii) tested logical and bio- logical ($p = 0.00$), iii) tested natural and bio-musical ($p = 0.040$), iv) tested bodily and bio- bodily ($p = 0.032$), and v) tested logical and bio- interpersonal ($p = 0.015$). None of the bio MI in the control group had any effect on student's science (biology) grade.

Table 9. Tested MI gain score and science (BIO) MI gain score using Pearson's correlation analysis to look for relationships for experimental and control groups.

Experimental	BIO Verbal	BIO Logical	BIO Visual	BIO Musical	BIO Bodily	BIO Inter	BIO Intra	BIO Natural	BIO Grade
Verbal	1.00 .000*	0.12 .269	0.02 .849	0.19 .092	0.11 .340	0.01 .340	0.16 .937	0.09 .404	-0.25 .024*
Logical	-0.07 .523	0.04 .281	-0.12 .701	-0.22 .041*	0.09 .396	-0.05 .658	0.11 .324	-0.05 .643	-0.03 .814
Visual	-0.01 .901	-0.22 .005*	-0.31 .041*	0.01 .894	-0.22 .043*	-0.09 .413	0.02 .847	0.12 .272	0.17 .117
Musical	0.01 .901	-0.05 .201	-0.14 .676	-0.14 .201	-0.04 .749	-0.14 .207	0.01 .956	-0.02 .863	-0.16 .152
Bodily	-0.17 .122	-0.04 .716	0.04 .711	-0.04 .687	0.10 .347	0.06 .600	0.05 .653	0.06 .565	0.13 .224
Inter	-0.05 .681	-0.12 .674	-0.05 .261	0.06 .559	-0.03 .797	-0.13 .259	-0.18 .104	0.07 .546	-0.02 .886
Intra	0.16 .146	-0.02 .185	0.15 .892	-0.18 .100	0.04 .710	0.01 .960	1.00 .000*	-0.08 .472	0.05 .663
Natural	0.09 .404	0.18 .901	-0.01 .106	0.19 .079	-0.18 .111	0.05 .644	-0.08 .472	1.00 .000*	0.09 .395
Control	BIO Verbal	BIO Logical	BIO Visual	BIO Musical	BIO Bodily	BIO Inter	BIO Intra	BIO Natural	BIO Grade
Verbal	0.00 .987	0.02 .868	-0.10 .413	0.12 .319	-0.09 .470	0.06 .639	0.11 .371	-0.03 .778	0.06 .638
Logical	0.24 .047*	0.43 .000*	-0.09 .481	0.21 .076	-0.23 .061	0.29 .015*	0.01 .941	0.11 .354	0.11 .365
Visual	0.09 .475	0.14 .263	0.01 .939	0.18 .148	-0.08 .551	0.03 .833	-0.16 .201	-0.06 .644	-0.10 .407
Musical	0.15 .227	-0.02 .881	-0.13 .301	0.09 .438	-0.26 .032*	0.02 .863	0.14 .262	-0.15 .220	-0.14 .245
Bodily	-0.03 .836	0.01 .906	-0.23 .057	0.10 .402	-0.10 .423	0.04 .724	0.03 .800	-0.09 .440	-0.05 .690
Inter	0.17 .152	0.08 .503	-0.10 .415	-0.04 .729	0.04 .774	0.19 .119	0.02 .881	-0.13 .306	0.22 .071
Intra	0.15 .215	0.15 .206	-0.23 .062	0.02 .891	0.08 .520	0.20 .098	0.18 .149	0.15 .234	0.16 .199
Natural	0.10 .434	-0.02 .900	-0.23 .061	0.25 .040*	-0.07 .572	-0.01 .949	0.13 .282	-0.07 .574	0.02 .870

* $p < 0.05$ level

First row = Pearson Correlation

Second row = p-value

The third analysis consisted of Pearson correlations of tested MI gain scores and non-science (non-bio) MI for the control and experimental group (see Table 10). Five noteworthy differences were found in the experimental group. The noteworthy comparisons consisted of: i) tested verbal and non-bio verbal ($p = 0.017$), ii) tested visual and non-bio naturalistic ($p = 0.020$), iii) tested intrapersonal and non-bio intrapersonal ($p = 0.005$), iv) tested logical and non-bio grade ($p = 0.007$), and v) tested bodily and non-bio grade ($p = 0.021$). Interestingly, in the experimental group, non-bio grades increased with tested logical and tested bodily intelligences.

Conversely, the control group had six significant relationships between tested MI and non-bio MI but none of those were similar to the tested MI and non-bio MI found in the experimental study. The significant comparisons in this analysis were, i) tested logical and non-bio logical ($p = 0.010$), ii) tested interpersonal and non-bio verbal ($p = 0.048$), iii) tested verbal and non-bio interpersonal ($p = 0.002$), iv) tested logical and non-bio interpersonal ($p = 0.002$), v) tested intrapersonal and non-bio interpersonal ($p = 0.003$) and vi) tested logical and non-bio naturalistic ($p = 0.042$, see Table 10). The results from the control group for bio and non-bio MI were consistent since none of the MI had any effect on student's non-science grade.

The third research question: What is the relationship between tested MI and perceived MI? Pearson's Bivariate correlation analysis of tested MI gain scores and perceived MI gain scored for experimental and control group were analyzed (see Table 11). There were 11 noteworthy correlations in the experimental group. Noteworthy

Table 10. Tested MI gain and non-science (Non-BIO) MI gain score using Pearson's correlation analysis to look for relationships for experimental and control groups.

Experimental	N-BIO Verbal	N-BIO Logical	N-BIO Visual	N-BIO Musical	N-BIO Bodily	N-BIO Inter	N-BIO Intra	N-BIO Natural	N-BIO Grade
Verbal	-0.09 .017*	0.05 .455	0.08 .649	-0.12 .485	-0.05 .288	-0.15 .641	-0.05 .179	0.01 .639	-0.09 .955
Logical	-0.15 .326	0.10 .174	0.04 .371	0.12 .732	0.09 .261	0.04 .431	0.07 .693	-0.30 .557	-0.15 .007*
Visual	-0.07 .284	-0.15 .507	0.02 .176	-0.08 .840	-0.17 .457	-0.25 .123	-0.25 .024	0.05 .020*	-0.07 .640
Musical	-0.11 .733	-0.12 .311	-0.08 .287	-0.09 .450	-0.08 .421	-0.04 .460	-0.16 .702	0.11 .162	-0.11 .322
Bodily	0.11 .707	-0.10 .317	0.12 .372	0.04 .284	-0.14 .69	0.17 .202	0.12 .130	-0.25 .280	0.11 .021*
Inter	-0.19 .208	0.09 .088	-0.07 .443	-0.06 .542	0.02 .573	-0.04 .829	-0.16 .745	-0.10 .156	-0.19 .393
Intra	-0.03 .476	-0.04 .788	0.00 .734	-0.11 1.00	-0.04 .328	0.30 .728	0.14 .005*	0.10 .222	-0.03 .392
Natural	0.13 .267	0.01 .242	0.05 .901	0.12 .669	0.08 .278	-0.13 .476	-0.04 .241	-0.05 .701	0.13 .669
Control	N-BIO Verbal	N-BIO Logical	N-BIO Visual	N-BIO Musical	N-BIO Bodily	N-BIO Inter	N-BIO Intra	N-BIO Natural	N-BIO Grade
Verbal	-0.07 .558	0.03 .825	0.02 .864	0.04 .766	0.20 .105	0.36 .002*	0.10 .422	0.12 .318	-0.07 .601
Logical	0.23 .054	0.31 .010*	-0.03 .800	0.11 .362	0.12 .321	0.37 .002*	-0.06 .597	0.25 .042*	-0.04 .759
Visual	0.06 .605	0.06 .631	0.00 .973	0.23 .057	0.08 .493	-0.08 .510	0.03 .780	0.20 .105	-0.15 .230
Musical	0.17 .161	-0.08 .499	0.02 .854	0.02 .875	0.03 .794	0.21 .083	0.15 .226	0.11 .352	-0.07 .573
Bodily	0.00 .971	-0.10 .413	-0.02 .840	0.13 .269	-0.06 .630	0.14 .242	0.19 .124	0.10 .437	0.00 1.00
Inter	0.24 .048*	0.07 .586	-0.02 .848	0.06 .603	0.15 .206	0.17 .166	-0.11 .367	0.10 .409	0.04 .769
Intra	0.08 .521	0.16 .185	-0.23 .063	-0.11 .356	-0.02 .861	0.35 .003*	0.19 .123	0.10 .391	-0.11 .384
Natural	-0.18 .128	0.07 .559	0.06 .623	0.16 .190	0.15 .225	0.07 .569	-0.12 .325	0.21 .078	0.00 1.00

* $p < 0.05$ level

First row = Pearson Correlation

Second row = p -value

comparisons were compared between: i) tested musical and perceived verbal ($p = 0.037$), ii) tested naturalistic and perceived verbal ($p = 0.001$), iii) tested interpersonal and perceived logical ($p = 0.001$), iv) tested visual and perceived visual ($p = 0.00$), v) tested musical and perceived visual ($p = 0.028$), vi) tested interpersonal and perceived musical ($p = 0.03$), vii) tested intrapersonal and perceived musical ($p = 0.040$), viii) tested logical and perceived bodily kinesthetic ($p = 0.011$), ix) tested natural and perceived intrapersonal ($p = 0.001$), x) tested bodily kinesthetic and perceived naturalistic ($p = 0.034$), and xi) tested interpersonal and perceived naturalistic ($p = 0.03$, see Table 11).

Contrary, there were 12 noteworthy correlations in the control group.

Interestingly, one of the significant correlations in the control group, interpersonal and perceived naturalistic ($p = 0.005$) was also observed in the experimental group.

Noteworthy correlations were found between: i) tested visual-perceived visual ($p = 0.000$), ii) tested logical - perceived musical ($p = 0.031$), iii) tested naturalistic - perceived musical ($p = 0.035$), iv) tested verbal - perceived bodily ($p = 0.029$), v) tested musical -perceived bodily ($p = 0.019$), vi) tested bodily -perceived bodily ($p = 0.000$), vii) tested intrapersonal - perceived bodily ($p = 0.040$), viii) tested intrapersonal - perceived bodily ($p = 0.024$), xi) tested interpersonal - perceived interpersonal ($p = 0.002$), x) tested intrapersonal - perceived interpersonal ($p = 0.002$), and xi) tested intrapersonal and perceived intrapersonal ($p = 0.001$), and xii) tested interpersonal and perceived naturalistic ($p = 0.05$, see Table 11).

Table 11. Tested MI gain score using Pearson's correlation analysis with perceived MI gain score for experimental and control groups.

Experimental	Perceived Verbal	Perceived Logical	Perceived Visual	Perceived Musical	Perceived Bodily	Perceived Inter	Perceived Intra	Perceived Natural
Verbal	-0.15 .178	0.17 .129	-0.01 .901	0.08 .468	0.02 .855	-0.05 .679	-0.11 .324	-0.16 .147
Logical	-0.18 .111	-0.02 .834	-0.12 .266	0.08 .482	0.28 .011*	-0.08 .489	0.01 .929	0.08 .485
Visual	-0.07 .556	-0.11 .304	1.00 .000*	0.02 .892	-0.09 .394	-0.07 .526	0.17 .124	-0.16 .149
Musical	0.23 .037*	-0.01 .932	-0.24 .028*	-0.14 .200	-0.09 .433	-0.06 .617	0.02 .843	-0.04 .729
Bodily	-0.14 .199	-0.04 .688	-0.14 .212	0.03 .789	-0.02 .852	-0.25 .023	-0.11 .321	-0.23 .034*
Inter	0.04 .731	-0.35 .001*	0.14 .210	-0.32 .003*	-0.03 .809	-0.16 .147	-0.12 .280	-0.32 .003*
Intra	0.16 .155	0.03 .782	0.02 .847	0.23 .040*	0.02 .845	0.15 .172	-0.11 .307	0.15 .183
Natural	-0.37 .001*	0.18 .111	0.12 .272	-0.01 .924	0.10 .371	-0.05 .655	-0.35 .001*	-0.15 .182
Control	Perceived Verbal	Perceived Logical	Perceived Visual	Perceived Musical	Perceived Bodily	Perceived Inter	Perceived Intra	Perceived Natural
Verbal	-0.10 .406	-0.14 .252	-0.02 .891	0.24 .051	0.26 .029*	0.03 .792	0.17 .153	0.05 .681
Logical	0.08 .535	0.16 .199	-0.03 .836	0.26 .031*	0.14 .251	0.24 .051	0.19 .127	0.14 .257
Visual	0.12 .310	0.16 .202	1.00 .000*	-0.10 .407	0.23 .056	-0.10 .395	-0.16 .180	0.02 .893
Musical	0.01 .913	-0.09 .452	-0.10 .407	1.00 .000*	0.28 .019*	0.07 .551	0.21 .091	0.12 .322
Bodily	-0.10 .409	-0.14 .267	0.23 .056	0.28 .019	1.00 .000*	0.06 .609	0.16 .181	0.20 .092
Inter	0.05 .683	0.16 .199	0.11 .388	0.14 .238	0.25 .040*	0.36 .002*	0.03 .788	0.34 .005*
Intra	0.17 .165	0.07 .575	-0.10 .395	0.12 .315	0.27 .024*	0.36 .002*	0.39 .001*	0.22 .064
Natural	-0.12 .310	0.03 .776	0.07 .580	0.25 .035*	0.08 .512	0.01 .966	0.10 .406	0.12 .335

* $p < 0.05$ level

First row = Person Correlation

Second row = p-value

The fourth research question: Which MI value correlates best with science courses vs. non-science courses? Bivariate Pearson's correlation analysis of science (bio) MI pretest and posttest scores were correlated with science and non-science course grades. The first analysis consisted of correlations of science MI pre-test and posttest responses for both experimental and control group (see Table 12). This analysis showed significant differences between student's grades when compared to verbal intelligence ($p = 0.02$) and bodily kinesthetic intelligence ($p = 0.04$) in the experimental group and visual intelligence ($p = 0.03$) in the control group. These negatively correlated relationships appeared to have some weight in student's overall performance and grade in class.

The second analysis to this research question consisted of Bivariate Pearson's correlation analysis of non-science MI pre-test and posttest responses for both experimental and control group (see Table 13). In the experimental group, natural intelligence ($p = 0.05$) showed a negative relationship with non-science grade. In the control group, none of the comparison relationships showed any interesting trends between non-science MI and grades.

Table 12. Science MI (pretest- and posttest) using Pearson's correlation analysis to look for relationships between science grades in the experimental and control groups.

Experimental	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural	Grade
Verbal	1.00	0.12	0.02	0.19	0.11	0.01	0.16	0.09	-0.25
		0.27	0.85	0.09*	0.34	0.94	0.15	0.40	0.02*
Logical	0.12	1.00	0.23	0.11	0.26	0.16	-0.02	0.18	-0.03
	0.27		0.03*	0.34	0.02	0.15	0.89	0.11	0.77
Visual	0.02	0.23	1.00	0.04	0.31	0.40	0.15	-0.01	-0.13
	0.85	0.03*		0.70	0.00*	0.00*	0.19	0.90	0.25
Musical	0.19	0.11	0.04	1.00	0.02	0.17	-0.18	0.19	0.06
	0.09*	0.34	0.70		0.85	0.13	0.10	0.08*	0.57
Bodily	0.11	0.26	0.31	0.02	1.00	0.22	0.04	-0.18	-0.23
	0.34	0.02	0.00*	0.85		0.04*	0.71	0.11	0.04*
Inter	0.01	0.16	0.40	0.17	0.22	1.00	0.01	0.05	-0.06
	0.94	0.15	0.00*	0.13	0.04*		0.96	0.64	0.56
Intra	0.16	-0.02	0.15	-0.18	0.04	0.01	1.00	-0.08	0.05
	0.15	0.89	0.19	0.10	0.71	0.96		0.47	0.66
Natural	0.09	0.18	-0.01	0.19	-0.18	0.05	-0.08	1.00	0.09
	0.40	0.11	0.90	0.08*	0.11	0.64	0.47		0.40
Grade	-0.25	-0.03	-0.13	0.06	-0.23	-0.06	0.05	0.09	1.00
	0.02*	0.77	0.25	0.57	0.04*	0.56	0.66	0.40	
Control	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural	Grade
Verbal	1.00	0.30	-0.08	0.10	0.09	0.28	-0.01	-0.07	-0.02
		0.01*	0.53	0.42	0.45	0.02*	0.92	0.57	0.87
Logical	0.30	1.00	0.18	0.06	0.01	0.23	-0.09	0.31	0.04
	0.01*		0.13	0.60	0.91	0.05*	0.47	0.01*	0.77
Visual	-0.08	0.18	1.00	-0.15	0.36	-0.09	0.10	0.20	-0.27
	0.53	0.13		0.23	0.00*	0.46	0.40	0.09*	0.03*
Musical	0.10	0.06	-0.15	1.00	-0.01	0.28	-0.11	0.07	0.14
	0.42	0.60	0.23		0.93	0.02*	0.38	0.57	0.24
Bodily	0.09	0.01	0.36	-0.01	1.00	0.09	0.08	0.12	-0.08
	0.45	0.91	0.00*	0.93		0.46	0.50	0.33	0.51
Inter	0.28	0.23	-0.09	0.28	0.09	1.00	-0.09	0.20	0.02
	0.02*	0.05*	0.46	0.02*	0.46		0.49	0.10	0.88
Intra	-0.01	-0.09	0.10	-0.11	0.08	-0.09	1.00	0.03	0.05
	0.92	0.47	0.40	0.38	0.50	0.49		0.79	0.68
Natural	-0.07	0.31	0.20	0.07	0.12	0.20	0.03	1.00	0.10
	0.57	0.01*	0.09*	0.57	0.33	0.10	0.79		0.42
Grade	-0.02	0.04	-0.27	0.14	-0.08	0.02	0.05	0.10	1.00
	0.87	0.77	0.03*	0.24	0.51	0.88	0.68	0.42	

* $p < 0.05$ level

First row = Pearson correlation

Second row = p-value

Table 13. Non-science MI (pretest- and posttest) using Pearson's correlation analysis to look for relationships between science grades in the experimental and control groups

Experimental	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural	Grade
Verbal	1.00	-0.19	0.26	0.14	0.11	0.45	0.02	0.29	-0.08
		0.08*	0.02*	0.21	0.34	0.00*	0.84	0.01*	0.47
Logical	-0.19	1.00	-0.15	0.18	0.09	-0.03	0.11	0.12	0.09
	0.08*		0.18	0.11	0.44	0.79	0.32	0.27	0.42
Visual	0.26	-0.15	1.00	0.09	0.27	0.35	0.14	0.32	-0.07
	0.02*	0.18		0.42	0.01*	0.00*	0.20	0.00*	0.53
Musical	0.14	0.18	0.09	1.00	0.31	-0.07	0.16	0.13	-0.01
	0.21	0.11	0.42		0.00*	0.54	0.16	0.25	0.94
Bodily	0.11	0.09	0.27	0.31	1.00	0.37	0.07	0.30	-0.01
	0.34	0.44	0.01*	0.00*		0.00*	0.51	0.01*	0.89
Inter	0.45	-0.03	0.35	-0.07	0.37	1.00	0.10	0.38	-0.03
	0.00*	0.79	0.00*	0.54	0.00*		0.39	0.00*	0.80
Intra	0.02	0.11	0.14	0.16	0.07	0.10	1.00	0.28	-0.02
	0.84	0.32	0.20	0.16	0.51	0.39		0.01*	0.85
Natural	0.29	0.12	0.32	0.13	0.30	0.38	0.28	1.00	-0.21
	0.01*	0.27	0.00*	0.25	0.01*	0.00*	0.01*		0.05*
Grade	-0.08	0.09	-0.07	-0.01	-0.01	-0.03	-0.02	-0.21	1.00
	0.47	0.42	0.53	0.94	0.89	0.80	0.85	0.05*	

Control	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural	Grade
Verbal	1.00	0.16	0.10	0.32	0.20	0.23	-0.12	0.26	0.19
		0.18	0.41	0.01*	0.10	0.05*	0.32	0.03*	0.12
Logical	0.16	1.00	0.25	-0.11	0.40	0.12	-0.06	0.32	-0.13
	0.18		0.04*	0.37	0.00*	0.34	0.64	0.01*	0.28
Visual	0.10	0.25	1.00	0.30	0.37	0.05	-0.20	0.15	-0.03
	0.41	0.04*		0.01*	0.00*	0.66	0.11	0.21	0.78
Musical	0.32	-0.11	0.30	1.00	0.26	0.17	-0.20	0.12	-0.05
	0.01*	0.37	0.01*		0.03*	0.16	0.10	0.34	0.67
Bodily	0.20	0.40	0.37	0.26	1.00	0.29	-0.41	0.42	0.07
	0.10	0.00*	0.00*	0.03*		0.01*	0.00*	0.00*	0.58
Inter	0.23	0.12	0.05	0.17	0.29	1.00	0.02	0.48	0.15
	0.05*	0.34	0.66	0.16	0.01*		0.85	0.00*	0.22
Intra	-0.12	-0.06	-0.20	-0.20	-0.41	0.02	1.00	-0.11	-0.23
	0.32	0.64	0.11	0.10	0.00*	0.85		0.36	0.07
Natural	0.26	0.32	0.15	0.12	0.42	0.48	-0.11	1.00	-0.06
	0.03*	0.01*	0.21	0.34	0.00*	0.00*	0.36		0.60
Grade	0.19	-0.13	-0.03	-0.05	0.07	0.15	-0.23	-0.06	1.00
	0.12	0.28	0.78	0.67	0.58	0.22	0.07	0.60	

* $p < 0.05$ level

First row = Pearson correlation

Second row = p-value

Exploration of the Quantitative Results

The primary purpose of the quantitative research study was to identify according to the inventory, the relationship of student learning behavior and exposure to MI curriculum. The second purpose was to determine the relationship of tested MI and criteria such as age, gender, and types of MI used in science and non-science courses. The third purpose was to determine the relationship between tested MI and perceived MI. The final purpose was to determine which MI value correlates best with science and non-science courses.

The relationship of student learning behavior and exposure to MI curriculum has brought about various significant differences of interest. The results indicate that students (experimental) when exposed to MI instruction have noteworthy differences in MI strength when compared to the control group. Paired t-test analysis for tested MI showed interesting distinctions between the experimental and control group. The experimental group showed noteworthy strengths in bodily kinesthetic and naturalistic intelligences while the control group had no significant differences in tested MI strengths. Similarly, paired t-test analysis for perceived MI showed interesting distinctions between the experimental and control group. The experimental group showed noteworthy strengths in perceived verbal intelligence while the control group showed strengths in musical and naturalistic intelligence. None of the noteworthy comparisons from the perceived intelligence analysis was similar in either groups.

Participants in the experimental groups reported less difference in MI instruction for science and non-science courses. For example, in the science MI paired samples t-test,

the experimental group indicated two noteworthy MI - visual and intrapersonal. Meanwhile, the control group indicated four noteworthy MI: verbal, logical-mathematical, intrapersonal and naturalistic. Paradoxically, for non-science MI, the experimental group showed no significant differences in MI strengths while the control group showed significant differences for logical-mathematical, interpersonal and intrapersonal intelligences.

The relationship of tested MI and criterions such as age, gender, and types of MI used in science and non-science courses have shown some interesting comparisons.

Gender differences were apparent in the experimental and control groups. Noteworthy MI was related to interpersonal intelligence when analyzing the experimental group. Females tend to rate themselves higher (more like themselves) for interpersonal MI than males. In the control group, visual intelligence was noteworthy as females rated themselves higher than males in this MI strength. However, the results from the control group in respect to gender should be regarded with skepticism since there were only five males in the control population ($n=69$). Concerning age, the experimental group showed significant differences between bodily kinesthetic intelligence and age. Participants in the age range of 18-20 years of age tend to rate themselves higher (more like themselves) for bodily kinesthetic intelligence. Contrary, the control group did not have any significant differences for age and tested MI.

The study revealed, tested MI of the experimental group showed noteworthy differences in their naturalistic and bodily kinesthetic tested MI while the control group had no noteworthy tested MI strength. Participants in the experimental group appeared to

rank themselves higher (somewhat like me) in the pre-test. Overall, tested MI and perceived MI did not share similar noteworthy results. The only worthwhile perceived MI in the experimental group was perceived verbal intelligence while the control group had more than one noteworthy perceived MI. The areas of perceived MI in the control groups worth discussing consists of musical intelligence and naturalistic intelligence. The paired t-test analysis revealed a difference between perceived MI and tested MI. This is worth investigating further as the participants are unacquainted with their "actual" or tested MI strength.

In the areas of science MI, the experimental group showed various significant differences in tested MI relationships. Interestingly, several MI strengths were negatively correlated when analyzed with Bivariate Pearson's Correlation analysis. These noteworthy relationships consisted of bio-verbal and tested verbal, science musical and tested logical and bio-bodily kinesthetic and tested visual. Meanwhile, noteworthy relationships, which were positively correlated consisted of science logical and tested visual, bio-visual and tested visual, bio-intrapersonal and tested intrapersonal and bio-naturalistic and tested naturalistic. The only tested MI strength that showed noteworthy differences was in participants science grade and tested verbal intelligence, which has a negative correlation.

Alternatively, the control group showed noteworthy relationships between science verbal and tested logical, science logical and tested logical, science musical and tested naturalistic, science bodily kinesthetic and tested musical and science interpersonal and tested logical. Tested logical appeared to have the most positive correlations with science

MI. In the non-science MI category, there was no significance found in the experimental group. However, in the control group, noteworthy implications in tested logical intelligence, tested interpersonal intelligence and tested intrapersonal intelligence were established.

The relationship between tested MI and science MI showed tendencies where tested verbal intelligence was highly correlated and significant to science grades and using verbal intelligence to study. Other important factors to look into are the relationships of logical and visual intelligence, logical and musical intelligence and bodily and visual intelligence. In the comparison of tested MI and science MI, the control group did not show similar relationships of MI as the experimental group. In the control group, none of the MI strength was noteworthy when compared to participants' science grades. The types of intelligence relationships that were significant were verbal and logical, musical and naturalistic, bodily and musical and interpersonal and logical intelligence. These comparisons merely suggest the appearance of a trend between these intelligences but the question is why and how do these paired intelligences react to one another. In tested MI with relation to non-science MI grades, the experimental group showed significance of non-science grades with logical and bodily kinesthetic intelligence. In relation to the control group, there were no significant difference between tested MI and non-science grades.

In relation to tested MI and perceived MI, relationships between perceived naturalistic and tested interpersonal intelligence, and perceived visual and tested visual were worth mentioning for both experimental and control groups. Apart from that, all

significant differences in MI for experimental and control were far from comparable. In the experimental group, comparisons for perceived verbal and tested musical, perceived verbal and tested naturalistic, perceived logical and tested interpersonal, perceived musical and tested interpersonal, perceived musical and tested intrapersonal, perceived bodily and tested logical, perceived visual and tested visual and perceived intrapersonal and tested naturalistic were found to be noteworthy.

For the control group, many noteworthy comparison relationships were found. These included comparisons between perceived musical and tested logical, perceived musical and tested natural, perceived bodily and tested musical, tested bodily, tested interpersonal and tested intrapersonal, perceived interpersonal and tested interpersonal, perceived interpersonal and tested intrapersonal, and perceived intrapersonal and tested intrapersonal. This pattern suggests Pearson's correlation of tested and perceived MI of the same intelligence could have a significant effect on the learning strength of an individual.

In determining which MI, value correlates best with science and non-science courses, the experimental group showed important differences in tested verbal intelligence and tested bodily kinesthetic and students' overall grade in science. Science MI of bodily kinesthetic and visual intelligence had the highest frequency of noteworthy comparisons when compared to the other MI while verbal, musical and interpersonal intelligence were a close second. In the control group, science visual intelligence showed a positive effect on overall science grade. Science MI of logical, visual, and interpersonal intelligences had the highest frequency of inference to each other.

The comparison between non-science MI and non-science grades, in the experimental group, identified the importance of naturalistic intelligences for non-science grades. Naturalistic intelligences also ranked the highest frequency of significance when compared to the other MI categories. Interpersonal, visual, bodily, and verbal intelligences were a close second in frequency of significance. Contrary, in the control group, intrapersonal intelligence was found to be significant with compared to non-science grades. However, in the control group, bodily kinesthetic intelligence surpasses all other intelligences in significant frequencies.

Qualitative Analysis

Data Description

The volunteer participants in the qualitative study were polled from the experimental and control group. A total of seven experimental groups (n=28) and six control groups (n=24) participated in the qualitative study (see Table 14). Students were interviewed in groups of four. Most of the answers to the discussions were hand written by the researcher because students felt more comfortable without the recording of their comments. Each interview session lasted 20-40 minutes. The length of the interview depended on the group dynamics and the willingness of the participants to elaborate their answers.

Table 14. Student demographic for qualitative study

CONTROL GROUP		EXPERIMENTAL GROUP	
1	3 females, 1 male	1	3 males, 1 female
2	4 males	2	2 females, 2 males
3	2 females, 2 males	3	3 females, 1 male
4	4 females	4	2 females, 2 males
5	2 females, 2 males	5	4 males
6	3 males, 1 female	6	4 females
		7	3 females, 1 male
TOTAL	24 students 12 females: 12 males	TOTAL	28 students 15 females: 13 males
Average age:	24 years	Average age	23 years
Ethnicity	24 Caucasians	Ethnicity	27 Caucasians, 1 African American
Grades expected in the course	4 A 10B 10C	Grades expected in the course	6 A 14B 8C

There were ten standard questions to the qualitative portion of the study, which were set up to reinforce the four research questions of the research study. The researcher also asked the students various comments and questions that were related to their answers when the opportunity was presented. Only the answers to the 10 standard questions are reported for this study.

1. How do you study in general?
2. Is there a difference in your study techniques for different courses?
3. What type(s) of teaching methods do you learn best from your instructors?
4. Do all your instructors use the same teaching methods for all courses? If yes – what are these methods and if no – what stands out as different.
5. Do you think that the type of teaching method by an instructor has any influence on your final grade in the course?
6. What are the qualities in an instructor do you look for when taking a course?

7. What are your studying strengths (ex. techniques) and how do you use them when it comes to learning something new?
8. Has there ever been a subject or topic in a course that was muddy (muddy point) to you and how did you overcome that?
9. What in your opinion is your best overall method of studying?
10. What is/are the teaching strengths that have been used by your instructors that have reached out to you and made you enjoy the subject?

Analysis of Relationship

The initial interviews asked participants of both experimental and control group to reflect on their courses at OTC and how many semesters have they been at OTC (see Table 15). The 50% of the participants were third semester students, 20% were second semester students while the remaining 30% were a mixture of first year, transfer students and students who were enrolled in four year colleges but were taking their general education courses at OTC.

Table 15. An overall summary of participant responses to qualitative questions for experimental and control groups.

CONTROL GROUP

Q 1	- Largely a combination of verbal linguistic, visual spatial and interpersonal
Q 2	Most students reported no difference - The reported difference was of Math, amount of time spent on math practice and the amount of time allotted to study may differ with difference courses.
Q 3	Mostly verbal and visual
Q 4	Most teachers have about the same technique. Stands out: enthusiasm, power point presentation, hands on teaching.
Q 5	Majority: At first yes, but for the final grade – it is up to the student to study. Minority: Teacher's fault if they get a bad grade
Q 6	Knowledge, Enthusiasm, able to relate to student's everyday lives, and diverse teaching methods
Q 7	Reading is a major component. Try various methods of learning – note card, rewriting notes, reading aloud.
Q 8	Science – read and review more often, labs are hands on review, flash cards, and group study Math – working on more problems English – seeking help from the writing center
Q 9	Reading, take good notes, study group
Q 10	Majority: subject that they enjoy, subject that is a part of their major. Minority: Teacher challenging them

EXPERIMENTAL GROUP

Q 1	-Largely a combination of verbal-linguistic, visual spatial, and interpersonal
Q 2	About half the students reported having different techniques. - The reported difference was of Math, amount of time spent on math practice and the amount of time allotted to study may differ with difference courses.
Q 3	Mostly verbal and visual
Q 4	Most teachers have about the same technique. Stands out: enthusiasm, power point presentation, hands on teaching, group work
Q 5	Majority: At first yes, but for the final grade – it is up to the student to study. Minority: Teacher's fault if they get a bad grade
Q 6	Knowledge, Enthusiasm, able to relate to student's everyday lives, and diverse teaching methods
Q 7	Reading is a major component. Try various methods of learning – note card, rewriting notes, reading aloud.
Q 8	Science – learning to use various ways to study, labs are hands on review, flash cards, and group study. Math – working on more problems English – seeking help from the writing center
Q 9	Reading, take good notes, study group and concept mapping.
Q 10	Majority: subject that they enjoy, subject that is a part of their major Minority: Teacher challenging them.

The responses of the students were categorized into various components of Gardner's MI. A list of terms, words and explanations used by students have been compiled and divided into the appropriate MI:

1. Verbal-Linguistic Intelligence: learning through listening, reading, note taking, re-writing notes, listing terms and note card/flash cards.
2. Logical-Mathematical Intelligence: learning through deduction, induction, logic, problem solving of categories and categorization, using graphs, and relationships.
3. Visual-Spatial Intelligence: using images, drawing diagrams, concept mapping, coloring, and visualization.
4. Musical Intelligence: making lyrics to a song, humming, using rhythm or melody.
5. Bodily-Kinesthetic Intelligence: hands on learning techniques, group work where movement is involved, and learning through the sensations of touch.
6. Interpersonal Intelligence: group study, tutoring with the tutors provided by OTC, sharing answers or quizzing each other, peer teaching and mentoring.
7. Intrapersonal Intelligence: words best alone, self paced, self instructed, self-motivated, likes having personal space and complete silence.
8. Naturalistic Intelligence: hands on ability to categorize items, and categorize species by common traits.

Question 1: How do you study in general?

Both experimental and control groups reported that they used a combination of verbal-linguistic, visual spatial, and bodily kinesthetic. 40% of the control group reported

using intrapersonal MI while only 35% of the experimental group reported using intrapersonal MI. Most students agreed that procrastinating as the key reason to their poor grades in class. Interestingly, several students in both control and experimental groups reported that some instructors gave them the test questions in the form of a study guide or practice test, while other instructors gave them the essay questions ahead of time. In those particular courses, memorization of the correct answers are key to their overall studying habits not so much a factor of understanding the material. Students in general agreed that mathematics and science courses were the most challenging and they had to pay attention to their studying methods and habits in those courses in order to be successful. With reference to 40% of the participants, they explained that the reason for their fear of mathematics and science were due to their unsuccessful experiences in high school and because those courses were traditionally considered the "hard classes".

Question 2: Is there a difference in your study techniques for different courses?

The 80% of the control participants reported no difference in study techniques for different courses. However, 20% of the control group reported that the only difference was how they approached their mathematics course. Many explained that mathematics was the only course that had homework and they spent a large amount of their time practicing mathematic skills and solving questions. A minority of 15% of the control group reported that the amount of time dedicated not necessary the study technique may differ with different courses.

The experimental participants were divided in their study techniques. About half the experimental participants reported not having any difference in study techniques for different courses while the other half disagreed. Students who disagreed mentioned that they approach all their courses with a different perspective after working on their science group-teaching projects. Some of the students have begun to tape their instructors so that they are able to listen to the lectures while driving. Others believed that using concept mapping and drawing their thoughts on pieces of paper help them to form concrete ideas. However, 40% of the experimental group reported that they spend more time working on their mathematics homework and assignments more than any other course. Like the control group, they believed that it is not necessarily studying techniques that differ, but the amount of time they put into studying.

Question 3: What type(s) of teaching methods do you learn best from your instructors?

Both control and experimental groups agree that listening to their instructors' lecture and visual cues like overheads and power point presentations help them to concentrate and understand the material. There were no differences of opinions in either group when it came to their preference in teaching methods or delivery. Students who were twenty five years old and younger preferred more videos, interactive animation, and web enhanced course sites (Blackboard enhancement) as a part of their course while older students (above 25 years of age) prefer the traditional lecture and note taking instruction. It was interesting to note that younger students (25 years or younger) preferred less interaction from the teachers while older students preferred more one on

one instructor interaction. About 30% of all participants mentioned how much they disliked being called to the board to solve problems in mathematics and science while 40% of all participants did not like being called upon in class to answer any questions. Many of the students (65%) preferred to take notes during lecture without any interruptions or interventions because they just want to know what to study for the test.

Question 4: Do all your instructors use the same teaching methods for all courses? If yes – what are these methods and if no – what stands out as different.

Most of the participants in the control and experimental group (90%) believed that most instructors have the same technique of teaching. Methods that differ were a combination of enthusiasm, the use technology, and hands on activities. Many of the students believe that there are pros and cons to group activities and dynamics.

Question 5: Do you think that the type of teaching method by an instructor has any influence on your final grade in the course?

65% of all the participants believed that the type of teaching method by an instructor might influence their grade initially. About half of all the participants believed that after the first exam (or even the second exam), students learn what the expectations of the instructors are, how the test questions are set up and perhaps they are more confident after the first exam jitters. Overall, the participants believed that it is the students' responsibility to study for the test. Contrary, 35% of the all participants believed that if they did not receive a "good grade" (grade B or better), it is not because

they did not study or understand the material, it is because the teacher did not teach or emphasize about the materials on the test.

Question 6: What are the qualities in an instructor do you look for when taking a course?

Both control and experimental groups agreed that an instructor who is knowledgeable, enthusiastic, and able to explain the material to their level of comprehension, and has diverse teaching tools like videos and overheads are important in their decision-making. About 40% of the all participants mentioned that they would take courses from instructors that were "recommended" by their friends. Participants also admitted that they inquired about "easy" instructors, instructors who give lots of extra credit or were "easy going". When asked what the term easy going meant – students explained that the instructor would be a laid back instructor who took late work or allowed them to make up late assignments or to turn in late assignments without penalty.

Question 7: What are your studying strengths (ex. techniques) and how do you use them when it comes to learning something new?

A majority of the control participants (70%) acknowledged that reading their textbook and notes were their main strength. 25% of the control participants would try different methods of studying such as seeking tutors or group studying. About 5% of the control, participants reported that they did not have any studying strengths and merely relied on chance or hope to see them through. Half of the participants shared valuable information on their past exposure to various learning theories in their psychology and

education courses. The exposure had helped them to reconsider the various forms of studying specifically for the control participants. The experimental participants (60%) noted that for the first time they had to put into practice what they learned in theory in their psychology courses in their science group-teaching project.

A majority (62%) of the experimental participants also reported reading their textbook and notes as their primary strength. The remaining 38% reported that they had tried various learning approaches from visiting the OTC counselor to attending the various how to study workshops provided by the college. Some of the experimental participants seek tutoring service from the academic achievement center at OTC for tutoring. About 50% of all the participants explained that they learned a little more about themselves in their science group assignment while 40% mentioned that they had already been exposed to various learning styles from their psychology and education courses.

Question 8: Has there even been a subject or topic in a course that was muddy (muddy point) to you and how did you overcome that?

The main three subjects that participants from control and experimental groups discussed were science, mathematics, and English. Both control and experimental groups agreed that for their science courses reviewing, learning to use multiple ways of reviewing (i.e. flash cards, rewriting notes, and reading ahead of time) have helped them to overcome muddy points. Science was like a foreign language to 60% of all participants. While in mathematics courses, all participants unanimously agreed that their primary concern was trying to get the right answer and practice is the key to

understanding mathematics. Most of the students agree that mathematics and science were the courses that "scared" them the most.

English courses are difficult for many of the participants because they never learnt to write research papers. The main primary concern for students with their English courses is writing essays. About 80% of all participants did not agree that writing skills are vital to their vocation. Furthermore, these participants do not like the writing component placed on various courses other than English. About 35% of all participants overcame their muddy point by transferring to another section, or dropping out of the course in order to take it at a different semester. Another 25% of the students reported that they would transfer from a full time faculty's course to an adjunct instructor because in their opinion and experience, adjunct instructors are not as demanding, and do not give as much assignments or essay exams as full time instructors.

Question 9: What in your opinion is your best overall method of studying?

The control participants unanimously agreed that reading and writing extensive notes is the best method of studying. In addition to reading and writing, 40% of control participants shared their past experiences of trying at least one different method of studying but many of them would always revert to the "basics of reading and writing". Contrary, 65% of the experimental participants believed that reading before class, taking good notes and reviewing are the best combination of studying. While 18% of the experimental participants believed that group work is the key, and the remaining 17% believed that concept mapping and drawing or visualizing the objectives of the course.

Question 10: What is/are the teaching strengths that have been used by your instructors that have reached out to you and made you enjoy the subject?

A majority (55%) of the control participants believed that it is not the instructor but the subject that makes them enjoy the course. While 45% of the control participants believed that the instructor's knowledge of the subject and notes given to the students, enabled them to enjoy the subject. A majority (55%) of the experimental participants shared similar believes as the control participants when it comes to their love for the subject regardless of instructor teaching methods or personality. About 40% of the experimental participants believe that the teachers ability to present the material with a variety of approaches have helped them in some time of the course to understand abstract concepts. Some of the students used the words "make us think" as a key method of instructors reaching out to them. Only 25% of both control and experimental participants attributed their success in various courses by the effort and time their instructor had invested in them. The rest of the participants believed that their success is due to their own effort and has nothing to do with the instructor.

An interesting point that 45% of all participants discussed was on the topic of grades. These participants (45%) believed that by paying their tuition, they should pass their courses without much effort or time spent on studying. In other words, pay the tuition, and get a passing grade. In addition, these participants also believed that instructors should understand that students work schedule and family obligation preceded course work. However, 30% of all participants believed that their grades should reflect

their studying effort not because they paid for their tuition. Mean while 25% of all participants had no comments or thoughts on this subject.

Exploration of the Qualitative Results

The purpose of the qualitative research study was to gather student views, feelings, and perception on how they study, methods of teaching that they found to be successful, and the overall idea of learning using MI without using the terms MI to avoid biases. Interestingly, both control and experimental groups had various similar comments to all of the research questions. Both control and experimental participants perceived themselves to use a large combination of verbal, visual and interpersonal MI methods of studying. Students also reported that most of them did not have separate or different studying methods with the exception of spending more time on certain courses such as mathematics.

Age also seemed to play an interesting role but again, there were no significant differences between control and experimental groups. Older students (above 25 years of age) preferred the traditional style of teaching, which consists of lecturing. Younger students (below 25 years of age) preferred a more interactive style of lecturing with the addition of technology and web based enhancement. The younger students expected instructors to provide the answers to exams instead of learning and comprehending the material. There were more statements on why they were not successful as a part of the instructors lack "giving us clues to the test" or giving us a study guide for the test instead

of learning the material and being able to critically think about the answer or respond to questions based on knowledge.

Both control and experimental groups appear to think that instructors who are enthusiastic and knowledgeable are important to their learning. Students in the experimental group felt that they were doing better in their courses because of their exposure of learning and teaching peers using different methods (i.e. MI) while control group did not have seem to have an opinion. Contrary, several students reported having prior exposure to various learning theories such as learning styles, brain based research, and MI from their psychology and education courses. The prior exposure to various learning theories could be a factor in the results of this research study. Therefore, students' perception and responses may be influenced by prior knowledge.

CHAPTER 5. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter discusses the findings of this research study as well as its limitations. This study focused on MI theory and its application to a community college setting in order to find out what its potential contribution to student learning and teaching techniques. Implications for future research are also speculated. This chapter is divided into three sections: discussion of results, conclusions, and recommendations.

Discussion of Results

The quantitative and qualitative study was designed with four purposes in mind. The first purpose is to investigate if there were any significant changes in student learning behavior when exposed to multiple intelligence curriculums. The second purpose was to explore significant differences when comparing student tested MI and criterions such as age, gender, types of MI used in science and non-science courses. The third purpose was to describe the relationship between tested MI and perceived MI. The fourth and final purpose was to consider which teaching MI value correlated best with science and non-science courses.

Question 1. Are there significant changes in student learning behavior once exposed to multiple intelligence curriculums?

The quantitative study revealed that participants from the experimental group showed significant difference in their tested naturalistic and bodily kinesthetic intelligences. Contrary, the control group did not show any significant tested MI strength.

Therefore, one could suggest that the intervention could play a role or make rather significant changes in student's tested MI. Experimental participants did not show significant differences for any of the significant tested MI, instead they showed significant difference in their perceived verbal intelligence. In addition to this, the control group showed noteworthy differences in their perception of MI. Both experimental and control groups showed significance in tested intrapersonal intelligence. The lack of pattern between tested and perceived MI analysis suggests that students' perception of themselves may differ from the limitations and definitions set forth by Gardner's MI definitions. Another possibility is of students not voicing out their concern, nor consciously thinking about their learning strength(s).

In the areas of science MI, the experimental group showed significance in tested visual and tested intrapersonal intelligence. On the other hand, the control group showed significance in tested verbal, tested logical, tested interpersonal and tested naturalistic intelligences. In the area of non-science MI, the experimental participants did not have any noteworthy non-science MI strengths. However, the control participants showed interesting relationships in MI strengths of intrapersonal, logical and interpersonal intelligences.

The qualitative study revealed that participants for the most part never thought of examining their studying habits. This suggests that such ideas are seldom consciously considered, verbalized, and might potentially be working against the students' best interest. Participants from the experimental and control groups reported that they used a combination of verbal-linguistic, visual spatial and bodily kinesthetic. Dweck and

Bempechat (1983) have been studying the influence of student's perception of learning and studying. These researchers surmised that students formed views of intelligence from the kinds of learning methods and activities provided by their teachers. Therefore, the participant responses and idea about studying methods may not be directly related to their MI strength or interest but to those of their instructors. Such perception may cause students to think that there is only one method of studying and hence, they are not able to do well in a class.

In terms of exposure to MI, the qualitative experimental group was more diverse in their approach for studying techniques for different courses. Many of the experimental participants noted that they have started to think critically about their studying habits after their science group-teaching project (research study intervention). However, similar to the control group, the experimental participants felt that in general the course that required the most time invested was mathematics. Both experimental and control participants felt that it is not the studying techniques that should differ, but the amount of time invested in studying. Therefore, even with the intervention, students who were exposed to MI curriculum may not necessarily change their approach. Becoming exposed and aware did not appear to facilitate active and conscious change of behavior.

Question 2. Are there significant differences when comparing student tested MI and criterions (dependent variable) such as age, gender, types of MI used in science and non-science courses?

In the experimental group, age had an interesting relationship to tested bodily kinesthetic intelligences (Pearsons correlation of 0.250). Participants in the age group of 18-20 years of age tend to rate themselves higher in bodily kinesthetic intelligence. Contrary, there were no noteworthy differences found between age and tested MI strength in the control group. The relationship of tested MI and gender is rather interesting. In the experimental group, gender was found to be significant with interpersonal intelligence. Females in the experimental group rated themselves higher on interpersonal intelligence than males. Contrary, participants of the control group had significant differences between visual intelligence and gender. Women in the control group ranked themselves higher on visual intelligence than men.

Various comparisons between tested MI and science MI were noteworthy but the main point to focus upon the results is of the comparison of tested MI and science MI. There were few comparable noteworthy relationships replicated in the experimental and control groups. The types of MI which had significant differences in student overall grades and effects of perceived MI teaching were unrelated in both experimental and control groups. However, interpersonal intelligence had the most frequencies of significant relationships for both experimental and control groups. In addition, interpersonal intelligence also affected student grades for the experimental and control groups. Even though there was a divergence in perceived MI, the expected overall grades

recorded by all participants were similar. Participants from both groups expected an average of a B in the science course and an average of a C in their non-science courses.

In tested MI with relation to non-science MI grades, there were no comparable noteworthy relationships replicated in the experimental and control groups. However, visual and bodily kinesthetic intelligences were frequently found to be noteworthy in the experimental group while, logical-mathematical intelligence was the dominant intelligence in the control group. The experimental group resulted in two intelligences that were noteworthy with students' grades; verbal and bodily kinesthetic intelligences while, the control group results in only visual intelligence, which was noteworthy when compared to students' grades. It appears that students' grades could be affected by the type of MI approach that an instructor uses but the extent of the approach differs with the construct of the student population.

In the qualitative study, the control participants unanimously agreed that reading and writing extensive notes is the best method of studying. In addition to reading and writing, 40% of control participants shared their past experiences of trying at least one different method of studying but many of them would always revert to the "basics of reading and writing". Contrary, 65% of the experimental participants believed that reading before class, taking good notes and reviewing are the best combination of studying. While 18% of the experimental participants believed that group work is the key, and the remaining 17% believed that concept mapping, drawing or visualizing the objectives of the course was the best way of studying.

Approximately 55% of the control participants believed that it is not so much the instructor but the type of subject. Mean while the remaining 45% believed that the instructor's knowledge of the subject and notes given to the students enable them to enjoy the subject. 55% of the experimental participants shared similar believes as the control participants when it comes to their love for the subject regardless of instructor teaching methods or personality. About 40% of the experimental participants believed, that the teachers' ability present the material with a variety of approaches have helped them in some time of the course to understand abstract concepts. Some of the students used the words "make us think" as a key method of instructors reaching out to them. Only 25% of both control and experimental participants attributed their success in various courses by the effort and time their instructor had invested in them. The rest of the participants believe that their success is due to their own effort and has nothing to do with the instructor.

An interesting point that 45% of all participants discussed is of getting a passing grade as long as they paid for their tuition. From responses and participant perspectives on their grades and expectations, it does not appear that the participants are taking their courses very seriously. Instead of wanting to understand and learn the information, 45% of all participants would rather complete the course(s) without retaining much of the information. This brings a twist to the research purpose of this dissertation, because it appears that many of the qualitative participant population would rather be studying the test instead of understanding the concepts and subject and how might this affect the absence or presence of MI in the curriculum.

Question 3. What is the relationship between tested MI and perceived MI?

In general, the participants tested MI and perceived MI was dissimilar.

Participants' perception of their MI strengths was very different from the tested MI. It appears that the participants may not fully understand their potential, or perhaps they have never had the opportunity to consciously question about their MI strengths. It is an interesting point of contention as adult learners of ages 18 and above, may not have fully appreciated nor honed into their possible skills and MI strengths that could be important in their career making decisions. The possibility of researching this complex difference might show how students at different age levels perceived and exemplify their ideals in learning, studying and preferred career choices.

However, participants in the qualitative study perceived a difference in their method of studying but without knowing their tested MI, it would be difficult to extrapolate their answers with certainty. However, the control and experimental groups agreed that there are differences when it comes to their methods of trying to study for a course versus the method taught by the instructors. Perhaps student's perception is based upon the method taught by their instructors, which is a more "powerful" tool than their actual (tested) MI strength.

Question 4: Which teaching MI value correlates best with science courses vs. non-science courses?

In determining which MI value correlates best with science and non-science courses, the experimental group responded with negative correlation of overall science

grade with verbal and bodily kinesthetic intelligence. Contrary, the control group responded with a negative correlation of overall science grade with visual intelligence. Visual and bodily kinesthetic intelligences were important MI in the experimental group as these intelligences were found to have highest frequency of significance among the groups. Contrary, logical mathematical, interpersonal and visual intelligence were the control group's highest frequency of significance.

The comparison between non-science MI and non-science grades, the experimental group identified the importance of naturalistic intelligences for non-science grades. Naturalistic intelligences also ranked the highest frequency of significance when compared to the other MI categories. Interpersonal, visual, bodily, and verbal intelligences were a close second in frequency of significance. Contrary, in the control group, there was no noteworthy MI when compared to non-science grades. However, in the control group, bodily kinesthetic intelligence surpasses all other intelligences in significant frequencies.

Participants of the qualitative study (both control and experimental groups) preferred lecture and instructional visual cues like overheads and power point presentations. There were no differences of opinions in either group when it came to their preference in teaching methods or delivery. There was an interesting difference in student's age and their want for the incorporation of technology. Participants, 18-25 years of age preferred more videos, interactive animation, and web enhanced course sites (Blackboard enhancement) and less instructor-student interaction. Older participants, above twenty-five years of age preferred the traditional lecture and note taking

instruction, and more one-on-one instructor interaction. Majorities of studies to date have been explored in classroom application at the elementary level (Campbell & Campbell, 1999; Campbell, Campbell, & Dickinson, 1999; Kornhaber, & Krechevsky, 1995; Maker et al., 1996), there are some interesting adult learning implications from this study which suggests MI instructional contributions may be noteworthy to higher education curriculum.

A consideration beyond the scope of this study is the role of school districts in and surrounding Springfield, Missouri in supporting MI curriculum and delivery of instruction. It may be significant for instructors to find out what curriculum their students are coming from and if the students are going to be prepared for the college experience. Many participants explained that before coming to OTC, they did not have good study skills and many of them were not prepared for the college experience. Courses like mathematics and English that have prerequisites for each level are helping these participants to be more prepared for their transferable college courses. Sadly, required courses such as BIO 100, non-majors biology have a lower success rate because many of the participants complained that they have problems reading and comprehending. They are not ready for conceptual and critical thinking questions, which are a part of doing and learning science. It should be noted that from this research study, a remedial science course might help to enrich student love and understanding of science instead of the fear of science as a subject.

Most of the qualitative participants in the control and experimental group believed that most instructors have the same technique of teaching specifically verbal-linguistic

intelligence. A majority of 90% of all participants preferred where a combination of instructors' enthusiasm, the use of technology, and hands on activities. The methods described by students do not comprise of Gardner's eight MI. There were only five of the eight MI that stood out with the participants: verbal-linguistic, visual- spatial, bodily kinesthetic, interpersonal, and intrapersonal. Why are there only a few and not all MI found to influenced the students studying or instructor's teaching methods even though at least half of the control participants have been exposed to various learning theories and the experimental group has been exposed to MI intervention? One possible explanation is because students tend to display attributes of the qualities teachers value most. Another is because even though students are highly creative, they tend to conform to their peers. More than 65% of all the participants believed that the type of teaching method by an instructor might influence their grade initially. About half of all the participants believed that after the first exam (or even the second exam), students learn what the expectations of the instructors are, how the test questions are set up, and perhaps they are more confident after the first exam jitters. Overall, the participants believed that it is the students' responsibility to study for the test. Contrary, 35% of the all participants believed that if they did not receive a "good grade" (grade B or better), it is not because they did not study or understand the material, it is because the teacher did not teach or emphasize about the materials on the test.

When asked about the teaching strengths preferred by participants, both control and experimental groups agreed that an instructor who is knowledgeable, enthusiastic, ability to explain the material to their level of comprehension and has diverse teaching

tools like videos and overheads are important in their decision-making. About 40% of the all participants mentioned that they would take courses from instructors that were "recommended" by their friends. Participants also admitted that they inquired about "easy" instructors, instructors who give lots of extra credit or were "easy going". When asked what the term easy going meant – students explained that the instructor would be a laid back instructor who took late work or allowed them to make up late assignments or to turn in late assignments without penalty.

Conclusions

The relationship between tested MI of experimental and control groups was fascinating as the control group did not have any significance with tested MI while the experimental group showed significance for bodily kinesthetic intelligence and naturalistic intelligence. A possibility for the test MI strength in the experimental group might be related to the intervention as students acquire conceptual understanding of the process of the scientific method; they begin to display high levels of participation in class. With an acquired sense of enjoyment in learning, they gain a more acute sense of their own strengths and weaknesses and perhaps learn how these might influence their learning (Adey, 1997).

The relationship between perceived MI of experimental and control groups were significantly different from the tested MI results. The control group showed significance in perceived musical and perceived natural intelligence while the experimental group only showed significance for perceived verbal intelligence. The results from the

quantitative analysis are intricate but with the help of the qualitative responses, there are several possibilities why the control group showed much significance. Participants explained that many of them were exposed to education and psychology courses that taught them about learning theories. Many of control participants had exposure to theories such as learning styles, brain research and even MI. It could be possible that after answering the pretest, they began to reevaluate their learning and/or MI strengths, which could possibly change their posttest responses. Also, since the participants from the experimental and control groups were enrolled in science courses, the science faculty have varied teaching methods which include hands on lab activities, lecture, varied usage of overheads and videos for all courses, written components in all exams, and mathematic equations are used rather frequently in all science courses. These multiple teaching and learning approach may not fall under the MI curriculum category but since there is more than one teaching method incorporated, perhaps the variety itself triggers a change in student behavior and perception of learning.

The results from Pearson's correlations of science MI, non-science MI and the pattern of participant answers in the qualitative study were similar to the past research on student learning in science. According to White (1996), the quality of science curriculum and student learning has received considerable attention in the past two decades as students confidence in their ability to learn science is highly related to their self perception of difficulty and the subject. White (1996) stated that "if they feel confused and belittled by the subject, they will abandon it; if, however, they feel confident in it and perceived a growing comprehension, they will continue" (p.125). In the classroom of the

experimental participants, the quality of student learning in science was enhanced considerably as participants from the qualitative study expressed their newfound ideas on their attitude towards studying and their learning curve. Although the experimental group reported that verbal and bodily kinesthetic intelligences were highly correlated to science grades, the control group showed that visual intelligence also had an interesting relationship to science grades. It appears only in areas that are significant, by offering students a variety in how they learn; students might be able to make learning more personalized and relevant (Adey, 1997). Perhaps that is the reason for the difference in MI significance and science grades between experimental and control groups.

Even though there are hundreds of past research evidence that show variability within and between genders (Gipps & Murphy, 1994; Miles, 1954; Nodding, 1992; Terman & Tyler, 1954), this research study did not find many significant differences between gender and tested MI. In the experimental group, tested bodily interpersonal intelligence and gender was significant as women rated themselves higher than males in this category. In the control group, tested visual and gender was significant as females ranked themselves higher than males in this area. However, the results of gender in the control group should be rejected since there were 64 females in the control group and only five males. The sample size for the male population was not robust enough for an appropriate representation of the group.

However, when perceived MI were correlated as a means of investigating into the matter of gender differences, the experimental group did not show any significance for perceived MI but the control group showed significance between perceived visual MI and

gender ($p=0.33$). Nevertheless, sample size for the control group of 64 females to five males is a reason for one to be skeptical about the significant value.

Tested MI when correlated with age also did not show any significance in the control group. However, there was one significance between age and tested bodily kinesthetic in the experimental group. For the qualitative study, age appeared to play a role in teaching preferences specifically in the usage of technology in the classroom. Participants who were younger (below 25 years of age) were very keen on instructors using more technology that is advanced and enhancements as a part of their course but older participants (above 25 years of age) preferred traditional methods of lecture and note taking instead. This difference in technological preference could attribute to knowledge, comfort zone when using computer.

Overall, given the chance to learn how to use the internet and the computer, most non-traditional students (above 25 years of age) are much more serious and studious about learning content, concepts, and understanding why the subject is vital to their degree program than younger students. During the interviews, most of the responses about grades and wanting to learn what is on the test were from the younger students (below 25 years of age) while the older students wanted to learn the reasons why and asked more questions pertaining to everyday life and how the concepts that they are learning is affected by the subject. There appears to be a trend in perceived learning and studying attitudes between students of difference ages during the interviews.

Science MI comparisons in the experimental group suggested that teachers should hone into students tested visual intelligence when trying to stimulate logical, musical,

visual and bodily methods of science teaching. This is especially true with verbal intelligence since it was highly correlated to students' performance in their science grades. However, in the control group, none of the MI had any significance on their overall science grades. Even though, it appears that teachers should hone onto students' logical intelligences when using science verbal, logical and interpersonal methods of science teaching. For both control and experimental groups, the most insignificant teaching method is the intrapersonal. This is most interesting since there is more group work in science courses from lab activities than most courses in the general education department at OTC.

Non-science MI suggested that teachers should hone into students logical and bodily kinesthetic intelligences when teaching, as these intelligences were significant in their overall non-science grades. Furthermore, only non-science verbal, intrapersonal and naturalistic intelligences were significant to the tested MI. Interestingly, for the control group, none of the tested MI were significant in their overall non-science grades. Teachers using interpersonal intelligences seemed to hone into the tested verbal, logical and intrapersonal intelligences of their students. In addition, non-science teaching methods using verbal, logical and natural had at least one significant effect on overall tested MI. Even though the participants from the experimental and control groups choose a non-science course to evaluate, there was an uneven representation for each category (Mathematics, English, Communication, History, and Psychology). Therefore, the results from this quantitative analysis is merely a generalized overview of non-science MI

teaching used in the courses and the types of teaching methods should be further research because there are some interesting trends in this area of study.

The difference between tested MI and perceived MI results and patterns is one of the most interesting relationships in this research study. One of the premises of the research was to investigate if adult learners are able to identify their MI – if their perception of MI is similar to tested MI results. It is apparent from the data; participants were not able to correctly identify their tested MI with their self-perceived MI. It might be possible that participants from both control and experimental groups were unaware of their “hidden MI strengths” or were not accustomed to consciously think about their studying habits or interests.

One possible reason for the difference between tested and perceived MI at the posttest is because once participants were exposed to the questions on the inventory (control and experimental) perhaps they began to question their MI strengths. From the qualitative research interviews, participants were found to state that they only use verbal and visual spatial as a part of their studying methods but were later found to investigate other types of studying methods such as interpersonal and bodily kinesthetic. It appears that a majority of adult learners in this student population do not seem to: i) have a set method of studying, ii) know what types of studying is suitable, and iii) are very keen on merely learning what they have to learn in order to graduate and not to become self actualized.

Recommendations

The result of this research study suggests a variety of possible education and curriculum reforms. Much of which should start with the students' attitude towards learning instead of classroom instruction or methods of teaching. Gardner (1993b) expressed that the education reform should reevaluate its focus on methodology and technologies. Gardner felt that "a significant part of our educational malaise lay in the mindless instruments that were conventionally used to assess student learning and, not incidentally, to signal what learning is" (1993b, p.152). Meaningful reform is attained if changes are directed to the fundamental concern of every student to reevaluate his or her idea of education. This cascade of meaningful reform should also trickle down to the educators and members of the human race. Educators should reevaluate their mission by integrating various fields of study so that students are able to apply and critically think about the impact they have on our ecosystem. Society has to take an active role to change education in terms of making students accountable for their actions or lack of actions and to educate the whole child not merely to feed their self-esteem.

Many educators embrace MI theory because it allows the student to find their voice or MI strength. The basic premise is that people are different and they have different ways of responding to information. The importance of accurate assessment is to improve student attitude, the learning environment and for students to understand that education is a privilege and a priceless gift. In the words of Thomas Angelo (1999):

That most assessment efforts have resulted in little learning improvement because they have been implemented without a clear vision of what "higher" or "deeper" learning is and without an understanding of how assessment can promote such learning. I'll also propose that our piecemeal attempts stem partly from a

mechanistic additive model of assessment, which needs to be replaced by a transformative assessment-as-culture-change model if we're to make real progress. (p.4)

The responses from the quantitative and qualitative research have made quite an impact on the recommendations for future research. First, a replication study with a larger and more diverse population of community college students would substantiate or refute the results of this study. In particular, the gender and age differences and difference between tested and perceived MI. Second, a longitudinal study of students from grade school to higher education could identify any changes of MI strength according to age, gender and career interest. Third, a comparative study that examines MI of student, teachers and methods of teaching in various courses would support regular MI inventory assessments such as the inventory tool used in this study. Finally, with the advancement of genetics and biotechnology, perhaps the controversial intelligence gene might open some light to intelligence and how various MI is used. This suggested list is far from exclusive as these questions are added to the list of countless research possibilities posed by various MI researchers all over the world.

Summary

This research study was a growing and learning experience for many of the participants including the researcher. The questions and results of the study merely scratched the surface of adult students of higher education and their views of MI teaching and curriculum. This research study poses unlimited questions and possibilities some include: What is the value of MI theory for college educators? What might a MI and non-

MI based science curriculum reveal about MI and student achievement at the community college level? Is there a difference of MI and MI attitudes between students enrolled in a community college vs. a four-year college? What is students' belief about MI and do these coincide with their teachers' and administrators' beliefs? What is the role of the college mission statement and environment in shaping the students' belief in education? Would prior knowledge of MI or any type of learning theories bring personal biases to inventories such as the one used in this research study?

Exploring these foundations of teaching and learning should be of considerable interest to all educators. The impact of these results could be fundamental to the reform of the American education system from K-college. There is great potential for integrated courses that focuses on all forms of interests such as multicultural and humanitarian aspects of life so students can achieve their optimal potential. There appears to be a vast possibility of student success in an integrated approach for richer learning environments that allow students to learn about themselves and the world around them.

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Appendix A: Pilot Study Survey

Thank you for participating in this survey. All responses and surveys are anonymous.

This survey delves into the teaching and learning needs of students at Ozarks Technical Community College (OTC).

The philosophy of this survey is to acknowledge that adult learners are highly capable and motivated with learning strengths and intelligences that are often underutilized by the methods used in studying, learning and teaching practices of the subject or the instructor. It is important to recognize that OTC strives to help educate and create a society of good citizens. Because of this conviction, we have chosen to look into the teaching and learning needs of our student population and to empower both the student and the instructor to learn what we can do to help each other.

Please use a 2B pencil to darken the correct responses on the scantron provided to you:

DIRECTIONS

Step 1 – Read each statement

Step 2- Use the scale below to answer the following questions:

A	Not at all like me
B	A little like me
C	Somewhat like me
D	A lot like me
E	Definitely me

1. I enjoy reading all kinds of reading materials
2. I can easily compute numbers in my head
3. I like working on jigsaw puzzles, mazes, and other visual puzzles
4. When I am bored, I find myself humming or tapping a tune
5. It is hard for me to sit still for long, I would rather be up and active.
6. Interacting with others helps me to learn
7. I regularly spend time alone reflecting or thinking about life questions
8. I love to take walks in the woods to learn about the plants and animals
9. Hiking and camping are enjoyable activities
10. I find that working alone is just as productive as working in a group
11. I like getting involved in social activities connected with my work, or community
12. I believe that a fit body is important to having a fit mind
13. Moving or dancing to the beat is easy for me
14. I am very good at reading maps and blueprints.
15. Math and/or science were among my favorite subjects
16. When working in a group I enjoy summarizing thoughts and sharing them
17. Taking notes is important for me to study, remember & understand
18. Multiple choice tests are easy for me
19. I like to draw, sketch or doodle
20. While working, studying or learning something new, I often sing or make tapping sounds
21. I participate in at least one sport or physical activity on a regular basis

22. People come to me for advice and help
23. I enjoy special hobbies or interests that I keep pretty much to myself
24. I enjoy taking photographs to observe the changes of the seasons & nature
25. I spend a great deal of time outdoors
26. I learn best when I enjoy or have an interest in the subject
27. I feel comfortable in the midst of a crowd
28. I learn best by hands on activities
29. The type of music I am listening to depends on my mood
30. Geometry is easier for me than algebra
31. Solving problems comes easy for me
32. Debates and public speaking are activities I would like to participate in
33. I enjoy word games like Scrabble, Passwords, and Boggle.
34. Outlining chapters helps me to understand the material I am reading
35. I enjoy reading material that has many pictures, or is heavily illustrated
36. I find it difficult to concentrate while listening to the radio or television
37. My best ideas come to me when I am busy in some form of physical activity
38. I prefer group sports like volleyball or softball to solo sports like swimming or jogging
39. I consider myself to be strong willed or independent minded
40. I enjoy categorizing things by common traits or characteristics

Learning is a natural process like breathing. It is part of our lives yet we do not realize this because it is unconscious. In 1983, Howard Gardner proposed the Theory of Multiple Intelligences through his book *Frames of Mind*. Gardner believes that there are eight intelligences that are independent; are developed at different times and to different degrees in all individuals. Everyone has all the intelligences and you can strengthen any intelligence. Multiple intelligence is not for labeling purposes but to empower us to learn about ourselves.

Questions 41-48 are each a definition from Gardner's 8 multiple intelligence.

DIRECTIONS

Step 1 – Read each statement

Step 2- Use the scale below to answer the questions below:

A	Not at all like me
B	A little like me
C	Somewhat like me
D	A lot like me
E	Definitely me

41. Verbal-Linguistic:

Learns best by saying, hearing, and seeing words

42. Logical-Mathematical:

Learns best by process logic, problems, and equations

43. Visual-Spatial:

Learns best by visualizing, dreaming, and working with colors, or pictures

44. Musical:

Learns best by rhythm, melody, and music

45. Bodily-Kinesthetic:

Learns best by touching, moving, and hands on learning

46. Interpersonal:

Learns best by sharing, comparing, relating, cooperating, and interviewing

47. Intrapersonal:

Learns best by working alone, self-paced instructions, and having personal space

48. Naturalistic:

Learns best by categorizing things, and being outdoors

SCIENCE COURSE EMPHASIS:

Please use your perception of your current science course to evaluate and respond to

QUESTIONS 49-56:

Which of the following intelligences are used in your SCIENCE course?	A. Never used	B. Seldom used	C. Moderately used	D. Frequently Used	E. Always used
49. Verbal-Linguistic					
50. Logical-Mathematical					
51. Visual-Spatial					
52. Musical					
53. Bodily-Kinesthetic					
54. Interpersonal					
55. Intrapersonal					
56. Naturalistic					

NON-SCIENCE COURSE EMPHASIS:

57. You should indicate which non-science course that you are using to answer the following questions. Please choose only ONE of the following courses that you have had or are currently taking at OTC to answer QUESTIONS 58 - 65:

A. Math B. English C. Communication D. History E. Psychology

Please use your perception of your chosen non-science course above (Question 57) to evaluate and respond to the following questions:

Which of the following intelligences are used in your NON-SCIENCE course?	A. Never used	B. Seldom used	C. Moderately used	D. Frequently Used	E. Always used
58. Verbal-Linguistic					
59. Logical-Mathematical					
60. Visual-Spatial					
61. Musical					
62. Bodily-Kinesthetic					
63. Interpersonal					
64. Intrapersonal					
65. Naturalistic					

Questions 66-69 are basic questions about the instructors of the courses that you chose to evaluate in this survey and about yourself:

66. My chosen science course that I used for this evaluation is taught by:

- A. Full time faculty, male B. Fulltime faculty, female
C. Adjunct faculty, male D. Adjunct faculty, female

67. My chosen non-science course that I used for this evaluation is taught by:

- A. Full time faculty, male B. Fulltime faculty, female

- C. Adjunct faculty, male D. Adjunct faculty, female
68. My gender: A. Male B. Female
69. My age: A. 18-20 B. 21-23 C. 24-26 D. 27-29 E. above 30
-

Multiple Intelligence survey questions and format:

Armstrong, T. Multiple Intelligence Inventory for Adults. Association for supervising curriculum development. Available from

<http://dcli.physics.drecai.edu/MI/armstrong.html>, Internet accessed, October 2000.

Webber, E. MITA Intelligence Survey. Available from

http://www.houghton.edu/personnel/eweber/center/new_page_2.htm, Internet accessed, October 2000.

Appendix B: Dr. Ellen Weber E-mail Correspondence for Permission to use MITA.

Subject:	RE: Permission
Date:	6/13/2001 5:42:33 PM Central Daylight Time
From:	Ellen.Weber@houghton.edu (Ellen Weber)
To:	MrsBscience@aol.com ('MrsBscience@aol.com ')

Nice to hear from you Ginny. I just completed a MITA conference with faculty of every discipline at the University of Monterrey in Mexico, and before that in Chile, SA. I fly home tomorrow. We had a terrific time!!!! In the meantime, do feel free to use MITA survey and include in addendum.

Congratulations! Do keep in touch. Best, Ellen

Appendix C: Dr. Thomas Armstrong E-mail Correspondence for Permission

Subject:	Re: Regarding permission
Date:	6/13/2001 5:56:19 PM Central Daylight Time
From:	tothomas@sonic.net (Thomas Armstrong)
Reply-to:	thomas@thomasarmstrong.com (Thomas Armstrong)
To:	MrsBscience@aol.com

Dear Ginny,

Reference as: This is actually from my book 7 Kinds of Smart (Penguin/Putnam). I'd suggest you get the book, check it against what you have, and then cite the appropriate pages or Armstrong, T., *Multiple Intelligences in the Classroom*. Association for Supervising Curriculum Development Multiple Intelligence Inventory for Adults
<http://dcli.physics.drexel.edu/MI/armstrong.html>

Sincerely,

Thomas Armstrong, Ph.D.

Appendix D: Research Study Survey

Ozarks Technical Community College

All participation in this survey is voluntary & anonymous. Thank you for your participation.

Please fill in the proper responses on the scantron provided:

DIRECTIONS: Step 1 – Read each statement

Step 2- Use the scale below to answer the following questions:

A Not at all like	B. A little like	C. Somewhat	D. A lot like	E Definitely
me	me	like me	me	me

- | | |
|--------------|---|
| 1. A B C D E | I enjoy reading all kinds of reading materials |
| 2. A B C D E | I can easily compute numbers in my head |
| 3. A B C D E | I like working on jigsaw puzzles, mazes, and other visual puzzles |
| 4. A B C D E | When I am bored, I find myself humming or tapping a tune |
| 5. A B C D E | It is hard for me to sit still for long, I would rather be up and active. |
| 6. A B C D E | Interacting with others helps me to learn |
| 7. A B C D E | I regularly spend time alone reflecting or thinking about life questions |
| 8. A B C D E | I love to take walks in the woods to learn about the plants and animals |

A Not at all like me	B. A little like me	C. Somewhat like me	D. A lot like me	E Definitely me
9. A B C D E	Hiking and camping are enjoyable activities			
10. A B C D E	I find that working alone is just as productive as working in a group			
11. A B C D E	I like getting involved in social activities connected with my work, or community			
12. A B C D E	I believe that a fit body is important to having a fit mind			
13. A B C D E	Moving or dancing to the beat is easy for me			
14. A B C D E	I am very good at reading maps and blueprints.			
15. A B C D E	Math and/or science were among my favorite subject(s)			
16. A B C D E	When working in a group I enjoy sharing and summarizing my thoughts			
17. A B C D E	Taking notes is important for me to study, remember, and understand			
18. A B C D E	Multiple choice tests are easy for me			
19. A B C D E	I like to draw, sketch or doodle			
20. A B C D E	While working, studying or learning something new, I often sing or make tapping sounds			
21. A B C D E	I participate in at least one sport or physical activity on a regular basis			
22. A B C D E	People come to me for advice and help			

A Not at all like me	B. A little like me	C. Somewhat like me	D. A lot like me	E Definitely me
23. A B C D E	I enjoy special hobbies or interests that I keep pretty much to myself			
24. A B C D E	I enjoy taking photographs to observe the changes of the seasons and nature			
25. A B C D E	I spend a great deal of time outdoors			
26. A B C D E	I learn best when I enjoy, or have an interest in the subject			
27. A B C D E	I feel comfortable in the midst of a crowd			
28. A B C D E	I learn best by hands on activities			
29. A B C D E	The type of music I am listening to depends on my mood			
30. A B C D E	Geometry is easier for me than algebra			
31. A B C D E	Solving problems comes easy for me			
32. A B C D E	Debates and public speaking are activities I would like to participate in			
33. A B C D E	I enjoy word games like Scrabble, Passwords, and Boggle.			
34. A B C D E	Outlining chapters helps me to understand the material I am reading			
35. A B C D E	I enjoy reading material that has many pictures, or is heavily illustrated			
36. A B C D E	I find it difficult to concentrate while listening to the radio or television			

- | | A Not at all like
me | B. A little like
me | C. Somewhat like
me | D. A lot like
me | E Definitely
me |
|---------------|--|------------------------|------------------------|---------------------|--------------------|
| 37. A B C D E | My best ideas come to me when I am busy in some form of
physical activity | | | | |
| 38. A B C D E | I prefer group sports like volleyball or softball to solo sports like
swimming or jogging | | | | |
| 39. A B C D E | I consider myself independent minded | | | | |
| 40. A B C D E | I enjoy categorizing things by common traits, or characteristics | | | | |

The following questions (Questions 41 – 65) are related to three categories:

My self perception = ME

Science course = BIO

Your chosen non-science course (see question 41) = Non-BIO

41. Please choose only ONE of the following courses taken at OTC. Use the course you selected below as your Non- BIO course for all questions regarding non-bio courses (44-65, 67-81 & 83).

A. Math B. English C. Communication D. History E. Psychology

DIRECTIONS

Please read each statement and respond using the scale below for questions 42- 65:

A Not at all like me B. A little like me C. Somewhat like me D. A lot like me E Definitely me

	Method(s) I use to study		
	ME (Self- perception)	BIO Course	Non- BIO Course
Saying, hearing, and seeing words	42.	43.	44.
Process logic, problems, and equations	45.	46.	47.
Visualizing, dreaming, and working with colors, or pictures	48.	49.	50.
Rhythm, melody, and music	51.	52.	53.
Touching, moving, and hands on learning	54.	55.	56.
Sharing, comparing, relating, cooperating, and interviewing	57.	58.	59.
Working alone, self-paced instructions, and having personal space	60.	61.	62.
Hands on ability, categorizing things by common traits, being outdoors	63.	64.	65.

DIRECTIONS

Please read each statement and respond using the scale below for questions 66- 81:

A Never B. At least once C. Sometimes D. Frequently E. All the time

	Teaching methods used by instructor	
	BIO Course	Non- BIO Course
Saying, hearing, and seeing words	66.	67.
Process logic, problems, and equations	68.	69.
Visualizing, dreaming, and working with colors, or pictures	70.	71.
Rhythm, melody, and music	72.	73.
Touching, moving, and hands on learning	74.	75.
Sharing, comparing, relating, cooperating, and interviewing	76.	77.
Working alone, self-paced instructions, and having personal space	78.	79.
Hands on ability, categorizing things by common traits, being outdoors	80.	81.

82. My BIO (science) course is taught by:

A. Male instructor

B. Female instructor

83. My Non-BIO (chosen non-science) course is taught by:
A. Male instructor B. Female instructor
84. My current grade for my BIO course is:
A. A. B. B. C. C. D. D. E. F.
85. My current grade for my chosen Non-BIO course is:
A. A. B. B. C. C. D. D. E. F.
86. My gender: A. Male B. Female
87. My age:
A. 18-20 B. 21-23 C. 24-26 D. 27-29 E. above 30
88. My ethnicity:
A. African American B. Caucasian C. Asian/Pacific Islander
D. Native American E. Hispanic F. Other

Appendix E: Key for Research Survey

Tested MI Scores

Questions 1-40 KEY	Intelligence
1, 16,17, 32 & 33	Linguistic Intelligence
2, 15, 18,31 & 34	Logical Mathematical Intelligence
3, 9, 14, 30 & 35	Visual Spatial Intelligence
4, 13, 20, 29 & 36	Musical Intelligence
5, 12, 21, 28 & 37	Bodily Kinesthetic Intelligence
6, 11, 22, 27, & 38	Interpersonal Intelligence
7, 10, 23, 26 & 39	Intrapersonal Intelligence
8, 9, 24, 25 & 40	Naturalistic Intelligence

Self Perceived MI Scores

Questions KEY	Intelligence
42	Linguistic Intelligence
45	Logical Mathematical Intelligence
48	Visual Spatial Intelligence
51	Musical Intelligence
54	Bodily Kinesthetic Intelligence
57	Interpersonal Intelligence
60	Intrapersonal Intelligence
63	Naturalistic Intelligence

Methods used to study science courses

Questions KEY	Intelligence
43	Linguistic Intelligence
46	Logical Mathematical Intelligence
49	Visual Spatial Intelligence
52	Musical Intelligence
55	Bodily Kinesthetic Intelligence
58	Interpersonal Intelligence
61	Intrapersonal Intelligence
64	Naturalistic Intelligence

Methods used to study non-science courses

Questions KEY	Intelligence
44	Linguistic Intelligence
47	Logical Mathematical Intelligence
50	Visual Spatial Intelligence
53	Musical Intelligence
56	Bodily Kinesthetic Intelligence
59	Interpersonal Intelligence
62	Intrapersonal Intelligence
65	Naturalistic Intelligence

Teaching methods – science courses

Questions KEY	Intelligence
66	Linguistic Intelligence
68	Logical Mathematical Intelligence
70	Visual Spatial Intelligence
72	Musical Intelligence
74	Bodily Kinesthetic Intelligence
76	Interpersonal Intelligence
78	Intrapersonal Intelligence
80	Naturalistic Intelligence

Teaching methods – non- science courses

Questions KEY	Intelligence
67	Linguistic Intelligence
69	Logical Mathematical Intelligence
71	Visual Spatial Intelligence
73	Musical Intelligence
75	Bodily Kinesthetic Intelligence
77	Interpersonal Intelligence
79	Intrapersonal Intelligence
81	Naturalistic Intelligence

Appendix F: Pilot Study Data

Tested Multiple Intelligence gain score correlated for pilot study – experimental and control group

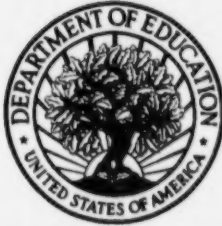
Experimental	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural
Verbal	0.00	-0.11	-0.11	0.00	0.22	0.00	0.21	0.00
		.966	.478	.103	.675	.868	.462	.674
Logical	0.00	0.00	0.00	0.00	0.22	0.00	0.21	0.00
	.966		.410	.807	.234	.715	.586	.681
Visual	0.00	0.00	0.00	0.00	0.22	0.00	0.21	0.00
	.478	.410		.716	.923	.431	.704	.007*
Musical	0.00	0.00	0.00	0.00	0.22	0.00	0.21	0.00
	.103	.807	.716		.353	.510	.775	.768
Bodily	-0.22	-0.22	-0.22	-0.22	0.00	-0.22	-0.01	-0.22
	.675	.234	.923	.353		.058	.015*	.039*
Inter	0.00	0.00	0.00	0.00	0.22	0.00	0.21	0.00
	.868	.715	.431	.510	.058		.762	.533
Intra	-0.21	-0.21	-0.21	-0.21	0.01	-0.21	-0.21	-0.21
	.462	.586	.704	.775	.015*	.762		.736
Natural	0.00	0.00	0.00	0.00	0.22	0.00	0.21	0.00
	.674	.681	.007*	.768	.039*	.533	.736	

Control	Verbal	Logical	Visual	Musical	Bodily	Inter	Intra	Natural
Verbal	0.00	0.20	-0.11	0.00	0.34	0.13	0.18	0.00
		.752	.995	.005*	.879	.365	.583	.654
Logical	-0.20	0.00	-0.20	-0.20	0.34	-0.07	0.18	0.00
	.752		.913	.485	.113	.259	.972	.455
Visual	0.00	0.20	0.00	0.00	0.34	0.13	0.18	0.00
	.995	.913		.103	.836	.186	.686	.000*
Musical	0.00	0.20	0.00	0.00	0.34	0.13	0.18	0.00
	.005*	.485	.103		.581	.339	.843	.102
Bodily	-0.34	-0.15	-0.34	-0.34	0.00	-0.21	-0.16	-0.34
	.879	.113	.836	.581		.067	.818	.017*
Inter	-0.13	0.07	-0.13	-0.13	0.21	0.00	0.05	-0.13
	.365	.259	.186	.339	.067		.393	.444
Intra	-0.18	0.02	-0.18	-0.18	0.16	-0.05	-0.05	-0.18
	.583	.972	.686	.843	.818	.393		.220
Natural	0.00	0.20	0.00	0.00	0.34	0.13	0.18	0.00
	.654	.455	.000*	.102	.01	.444	.220	

* $p < 0.05$ level

First Row = Gain score mean

Second Row = p -value



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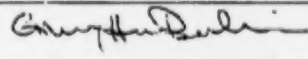
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